

The Conducting of a Mining
Negotiation Showing the
Scheme of Engineering
Involved

by George T. Hansen

1911

SPresented to the College of Engineering
of the University of Kansas in application for
the Degree of Mining Engineer.

T H E S I S

"The conducting of a Mining Negotiation Showing the Scheme of Engineering Involved."

Taken from Actual Practice

b y

GEORGE T. HANSEN

MINING SALES ENGINEER

ALLIS CHALMERS COMPANY

ST. LOUIS, MISSOURI

Presented to the College of Engineering of the University of Kansas in application for the Degree of Mining Engineer.

F O R E W O R D

There is practically no limit to the different problems in Engineering which a Sales Engineer is called upon to solve. Not only the arrangement and design of hoisting, sampling, crushing, milling, concentrating, smelting and refining plants with their auxiliary power, pumping and lighting requirements, but the even more difficult problems of rearrangement of old plants for greater efficiency in operation or recovery and the adapting of special machines or combinations of machines to suit each special requirement which the mining field has to offer, come under his jurisdiction. Any of these problems involve responsibility and the solution of each is a matter of actual engineering practice.

Therefore the writer can think of no more fitting subject for an Engineering Thesis than the outlining of one of these negotiations showing work actually done in the regular course of business.

The work is followed through the preliminary stages of investigation of the property, the arrangement of all parts of the plant with respect to local conditions, general design of each section, the form of specifications and the letters of recommendations. Details of price are omitted for obvious reasons.

P R E L I M I N A R Y W O R K

The first and most important task, - that of locating the shaft on this property was easily done, since the owners had sunk diamond drill holes enough to prove it, and the records were on file.. A careful study of these records from their positions on the surface, served to locate the entire ore body. A graphical sketch of this ore body furnished the means of locating the approximate center which happened to be near a fault of limestone running through the body. With this location as a basis to work on, and, bearing in mind the most essential physical features, of shaft sinking, such as character of the ground, drainage, waste disposal together with general contour of surface and available adjacent space for necessary buildings; the shaft was located as shown on the accompanying drawing. The site chosen was at the top of a steep slope where the grade became gentler, thus furnishing a comparatively level space for hoist house and gallows frame, and a steep slope for location of the crushing plant operating under the gravity system, and ample dumping ground for barren rock. After the first twenty feet, the drills at this point showed solid limestone for the remainder of the two hundred eighty five feet to the shaft bottom.

The location of the shaft in this manner settled

the question of position of the crushing plant. In mills of this tonnage, it is better to have an outside dry crushing plant for several reasons, as follows:-

1. The plant can be made sufficiently large to handle a 24 hour mill tonnage in 8 hours, with the same labor, this making the plant flexible as to storage and saving one-third of the operating labor.

2. The plant can operate in halves and if breakages occur in one section, the other can be operated to furnish a full mill tonnage in 16 hours.

3. Dry crushing prevents sliming of the ore and furnishes a more uniform product.

4. The reduction of several classes of ore from different sections of the mine and storage in crushed ore bins, mixes and forms a uniform blend thus subjecting the concentrator to no uneven qualities of feed.

5. The abrasion on wearing parts is less when crushing dry.

6. The slope of ground can be utilized for each plant and the site best fitted may be chosen for each.

The choosing of the concentrator site brought into consideration the following features.

1. Slope of site, - a much gentler slope than that required for the crushing plant.

2. Water supply under proper head.

3. Space for tailings disposal.

4. Accessibility for switching tracks.

As these points were considered in the location of

the shaft, the concentrator was located on a site just far enough from the crushing plant for a belt conveyor to reach from the discharge point of the crushing plant to an elevation of 40' at the concentrator to provide for ore storage bins. After the approximate location had been thus fixed, a line of levels was run up from the river below, and a suitable site for a water storage reservoir selected. The elevation of the concentrator was then adjusted to meet the water level in the reservoir, to furnish water to the screens at the top of the concentrator under a 15 foot head. At the same time, the location was made such that a gravity system of tailings disposal could be maintained, with all available space for storage.

The location of the power house was a matter of convenience in fuel and water supply and central as to transmission.

An interesting feature of our power house location is that of water supply. On account of the high elevation of water, it is necessary to lift in two stages when operating centrifugal pumps. The water is not clean which makes centrifugal pumping a necessity. Therefore, the location of the power house, allows the water to be pumped from the river, through the condenser for the first stage and from the hot well to the reservoir for the second stage. This feature not only does away with a large amount of pumping but gives the water sufficient heat to prevent freezing in the pipes or reservoir in winter.

The pumps were located as near the river as possible and sufficiently high to be above high water mark.

After the general location and arrangement was completed, the design of the different sections was a question of technical arranging and balancing as may be followed out in the accompanying specifications, drawings and recommendations.

The character of the lead ore of this section as judged from a general knowledge of that of surrounding mines, and the study of drill cores, is so disseminated that it requires grinding down to 9 m/m before concentration begins. We design our crushing plant accordingly, taking into consideration the adaptability of each machine to certain work and the capacity and power required in each case. The drives are arranged to be as flexible as possible and to effect all possible saving in friction load.

In the concentrator, the machines best fitted for the requirements are chosen, and balanced as in the crushing plant.

Details of the work will be found in the following pages, viz.-

1. Full specifications.
2. Distribution of Power.
3. Water requirements.
4. Flow Sheet.
5. Description of operation.
6. Special Features.

GENERAL PLANT DRAWING

St. Louis, Mo.
June 6, 1910.

Potosi Lead, Baryta & Mercantile Company,
Potosi, Missouri.

Gentlemen:-

(Attention - Mr. Norris.)

We are furnishing you herewith proposals covering mine equipment for your property at Leadwood, Missouri. The general arrangement and location of shaft, crushing plant, concentrator, power-house and pump house was governed by due consideration of surface contour, tailings disposal, railway facilities, water supply, power distribution and ease of handling materials over the entire plant. A more detailed discussion of the various sections of the plant will tend to show the advantage of the location of each.

SHAFT:-

You are familiar with the various points considered in the location of this shaft. This location was partially governed by the position of the crushing plant site and the two are so situated that the ore can be hoisted in the shaft and dumped automatically into the storage bin in the crushing plant. The shaft will be two compartment, equipped with two combination cages and skips, operated by a double drum electric hoist. The operation will be in balance during the greater part of the time, but the hoist will have sufficient power to raise an un-

balanced load for an indefinite period of time. This arrangement avoids a complete disabling of the plant in case of accident to one cage. As the balanced hoist will have a raising capacity of more than 600 tons of ore per 8 hours shift, there will be no difficulty in keeping the plant in full operation by running one cage during two shifts. The extra hoisting capacity was arranged not only for continuous operation, but also to handle the increased tonnage if the capacity of the concentrator should be doubled.

CRUSHING PLANT.

For a number of reasons a dry crushing plant located outside of the concentrator is preferable in your locality. The abrasion of wearing parts in machines is less, the dust is confined to the dry-grinding section, the amount of slimes is less, the handling of material in storage is facilitated and the site can be chosen with greater slope than in the concentrator with a consequent utilizing of gravity in the flow of material. Therefore the crushing plant is located on the steepest slope near the concentrator and just below the shaft. The general plan of operation as shown on the accompanying flow sheet, is as follows:-

The nine run of ore is dumped automatically from the skips into the bin at the top of the crushing plant. The lump ore is fed through a wide quick-opening gate operated by a lever in the hands of the crusher - attendant, falling directly into the hopper of the #7-1/2 "K" breaker. In this machine the ore is reduced to 3-1/2" and smaller and discharge into two Gates Iron Frame Revolving Screens

fitted with 2" perforated sections and 9 m/m perforated steel dust jackets. Starting at the two screens above, the crushing plant is divided into duplicate sections, each designed to handle one-half of the capacity of the entire plant, - each section being as follows:- The oversize from the 2" screen discharges into a #4 "K" breaker set to crush to 2" and smaller and discharging into a #6 "B" elevator which raises the product to the screen floor and discharges into the same revolving screen as before, this reducing all of the material to 2". The ore through the 2" sections and over the 9 m/m dust jacket discharges into one set of 36" x 15" A Rolls set to crush to 3/4" and discharging into the 16" vertical mill elevator which raises the material to a second 48" x 16' Gates screen fitted with 9 m/m perforated steel sections. The oversize from this screen passes to a second set of 36" x 15" "A" Rolls which reduce to 9 m/m and discharge into the same elevator and screen. Thus the material is reduced to 9 m/m and each of the screen housings terminates in a spout which feeds the crushed ore on to the 20" troughing belt conveyor. This conveyor discharges to a 20" inclined conveyor which carries the ore to the mill storage bin for distribution.

The crushing plant is operated by two 100 Horse Power and one 75 Horse Power Induction motors, the power being distributed as follows:-

1 - 7-1/2 "K" Breaker -----	55 H.P.
1 - #6 "B" Elevator -----	12 "
1 - 20" Conveyor -----	3 "
Transmission -----	2 "
Total -----	72 "
Motor Power -----	75 "

Two sections each as follows:-

1	-	#4 "K" Breaker	-----	16	H.P.
2	-	48" x 16' Screens	--	19	"
1	-	18" Elevator	-----	11	"
2	-	36" x 15" Rolls	----	40	"
		Transmission	-----	8	"
		Total	-----	94	"
		Motor Power	-----	100	"

From the above distribution of drives, it is apparent that the main crusher and either of the auxiliary halves of the plant may be operated without the other, thus forming a flexible installation.

The crushing plant is arranged to be equipped with trolleys and tracks above the machines to receive chain blocks in making changes of wearing parts of the crushers and rolls.

The capacity of the crushing plant as arranged will be 500 tons in eight hours, so that sufficient ore may be hoisted and crushed in one shift of eight hours to operate the concentrator for twenty-four hours. This added capacity will also allow for a doubling of capacity in the concentrator.

CONCENTRATOR.

The inclined conveyor elevates the 9 m/m material to the top of the mill bins where it discharges on a horizontal troughing conveyor and is distributed by a self-propelling tripper. The bins are designed for a capacity of 1200 tons of crushed ore or two days run, thus making the total ore storage in the mill and crushing plant equal to three days mill capacity, this insuring continuous operation.

The ore is fed from the centers of the bottom of

the bins through four shaking feeders any two of which will feed the mill at its maximum capacity. The feeders discharge the ore at a uniform rate into launders where water is added through nozzles, the stream flowing to two 16" elevators which raise the ore to two (2) 48" x 108" trommels fitted with 1 m/m perforated sheet steel covering. The oversize from these trommels representing ore between 9 m/m and 1 m/m feeds the 25' Hancock Jig which produces concentrates in the 1st, 2nd, and third compartments, middlings in the fourth and fifth compartments and tailings in the sixth compartment. The concentrates flow directly to the dewatering tank in the basement. The fourth hutch or high-grade middlings are reground in one set of 30" x 14" "B" Rolls after being thickened in a dewatering box. The rolls are more satisfactory in regrinding the high-grade middlings as their use avoids sliming and an extremely fine product is not desired from this material. The fifth hutch or low grade middlings flow to a 6' Anaconda Huntington Mill, which regrinds to the required fineness, discharging the product together from that of the rolls into a 16" vertical elevator which raises the reground middlings to the screen floor and to a 48" x 108" trommel fitted with 1-1/2 m/m perforated sheet steel covering. The oversize from this trommel flows to the Hancock Jig. The three trommels are driven from a single shaft by special jaw clutches and are so arranged that any screen may be thrown out at any time for replacement of screen coverings without interfering with the operation of the other two. Likewise the fourth hutch middlings may be discharged into the Huntington Mill or the fifth hutch into the rolls during repair on either of these

machines. The fine material through the three trommels flows to three 48" dividing cones which take off a part of the water and slimes which flow directly to three 8' Callow cones. The spigot or coarser products from the dividing cones, flow to three Richards Hindered Settling Classifiers with four spigots each. These classifiers divide the ore into four sizes of table feed, each classifier feeding four standard Overstrom Tables. The twelve tables make three products, - concentrates, middlings and tailings. The concentrates flow to the dewatering tank. The middlings are treated on three Standard Overstrom Tables in the basement and the tailings flow to the sump tanks from where they are pumped to a sufficient elevation to join the jig tailings and discharged to the tailings dump. The middlings tables produce concentrates and tailings, the former joining the other table concentrates, the tailings flowing to the sump tanks as above. The thickened slime from the six calow cones is treated on six suspended Iron Frame Vanners which produce concentrates and tailings. The concentrates flow to settling tanks in the basement; the tailings flow to the sump tanks. From the dewatering tank, the jig and table concentrates are elevated by a drag conveyor and discharged into cars on the loading track or into a small concentrates bin on the basement floor. The survey of the property shows sufficient area available by gravity flow to dispose of the tailings for a period of one year, after which time a conveyor or elevator may be erected to dispose of the tailings for an indefinite period. The erection of a dewatering tank on the opposite side of the track from the mill will provide a means of

loading all or any portion of the tailings into cars for shipment.

The mill will be provided with overhead trolley, and chain blocks for making replacement of wearing parts on the roll and Huntington Mill. The roll will be driven by a clutch pulley and the Huntington mill provided with tight and loose pulleys so that either may be stopped without interfering with the mill operation.

The mill will receive power from motors distributed as follows:-

Inclined conveyor -----	17	H.P.
Horizontal " -----	4	"
Transmission -----	2	"
Total -----	23	"
Motor Power -----	30	H.P.
4 Feeders -----	8	"
Transmission -----	1	"
Total -----	9	"
Motor Power -----	10	"
Drag Conveyor -----	5	"
Motor -----	5	"
6 Overstrom Tables -----	6	"
6 Suspended Vanners -----	3	"
Transmission -----	3	"
Total -----	12	"
Motor Power -----	15	"
6 Overstrom Tables -----	6	"
3 " " -----	3	"
Transmission -----	3	"
Total -----	12	"
Motor Power -----	15	"
3 48" x 108" Trommels --	8	"
3 16" Elevators -----	27	"
Transmission -----	3	"
Total -----	38	"
Motor Power -----	40	"
1 30" x 14" "B" Roll ---	16	"
1 6' Huntington Mill ---	15	"
1 Hancock Jig -----	5	"
Transmission -----	3	"
Total -----	39	"

Motor Power ----- 40 H.P.

2 5" Centrifugal Pumps - 40 "

Motor Power ----- 40 "

PUMPS.

The amount of water necessary for mill consumption will be from 1500 to 1800 gallons per minute. This will be supplied to a reservoir above the mill and pumped from Big River level, necessitating an elevation of 145'. We have arranged to elevate this water in two stages, pumping first through the condenser at the power house and from the hot well to the reservoir. The first stage will require a capacity of 2000 gallons per minute, against a head of 50' including condenser height and pipe friction. The pump will be supplied from the river through a canal excavated to the pump house and the pump will be protected against a rise of 22' in Big River, which is high-water mark.

The second stage will require a capacity of 2000 gallons per minute against a head of 126' including pipe friction.

In each case the pipes will be provided with check valves and drains.

The power required is as follows:-

1st Stage	-----	60 H.P.
2nd Stage	-----	110 "
Total	-----	170 "

POWER HOUSE.

The total power required in the plant is as follows, figuring motor sizes:

Hoist	-----	120 H.P.
Crushing Plant	-----	275 "
Carried Forward	--	395 "

Carried Forward	---	395	H.P.
Concentrator	-----	165	"
Conveyors	-----	30	"
Pumps	-----	170	"
TOTAL	-----	760	"

This power will be divided as follows:-

Intermittant Load (Hoist)	120	H.P.
Constant Load (8 hrs.)	---	365 "
" (24 hrs.)	---	275 "
TOTAL	-----	760 "

For this power we have specified a 725 K.V.A. generator, direct connected to a 22" and 44" x 42" cross compound condensing engine.

For operating ten air drills underground, we have specified a 1000 cubic foot per minute cross compound condensing compressor with two stage air cylinders.

For excitation, we have specified a 50 K.W. 120 volt, D.C. Generator, direct connected to a 11" x 12" High speed engine. This unit will also furnish current for lighting the plant.

The compound engine and compressor will exhaust into a 42" Barometric condenser which will furnish a 26" vacuum with 70° injection water.

The high speed engine will exhaust into an open type heater and furnish hot water for boiler feed.

The steam will be generated in a battery of three water tube boilers arranged to maintain two in operation and one spare.

The boilers will be fed by duplex pumps in duplicate, one for operation and one spare.

The plant will be so located that the track below

the concentrator will reach the coal storage space at a sufficient elevation above the floor to provide ample storage room.

BUILDINGS.

The drawings which we have made are general and furnish the means of quoting intelligently on the equipment required in this plant. They also show the outside dimensions of the buildings, but are not sufficiently in detail to furnish more than an approximate estimate on the cost of the steel buildings. Therefore, we have not included in the proposal, the cost of buildings, but furnish herewith, the approximate cost of same.

Material and labor required to manufacture and deliver on board cars at Leadwood, Missouri, steel work for hoist-house gallow-frame crushing-plant, concentrator, pump-house and power house, including painted corrugated sheet steel covering, ridge roll and flashing, pivoted and fixed windows, hinged and sliding doors with frames and hardware. Purchaser to deliver material from cars to erection site. Price below includes erection of buildings complete, on foundations to be furnished by the Purchaser, but does not include the erection of equipment in the buildings or the building of wood floors.

Total Price -

DRAWINGS.

With the order for the equipment, we will furnish detailed drawings of such a nature that final estimates on the steel work may be secured, these drawings being com-

plete in covering the erection and building of the plant and the installation of equipment therein.

ERECTION.

Our policy in the erection of plants is to furnish equipment, complete drawings and the services of one or more competent erecting engineers to superintend the erection of the equipment, complete. Local labor and wage conditions make this method advisable and as the Purchaser is always better acquainted with these conditions and through his permanency, better able to cope with them, the method has been almost universally adopted. We have, therefore, quoted you in this way, stating the cost of services of our superintendents, which we trust will be satisfactory.

Together with the proposal, flow sheets and drawings, the above furnishes you complete information on the plant which you propose to install, representing a completely balanced set of units so arranged as to give the highest efficiency, under continuous operation and each unit complete within itself and specially arranged for the work required.

We shall be pleased to receive your valued order for the equipment specified and, in anticipation, we remain,

Very truly yours,

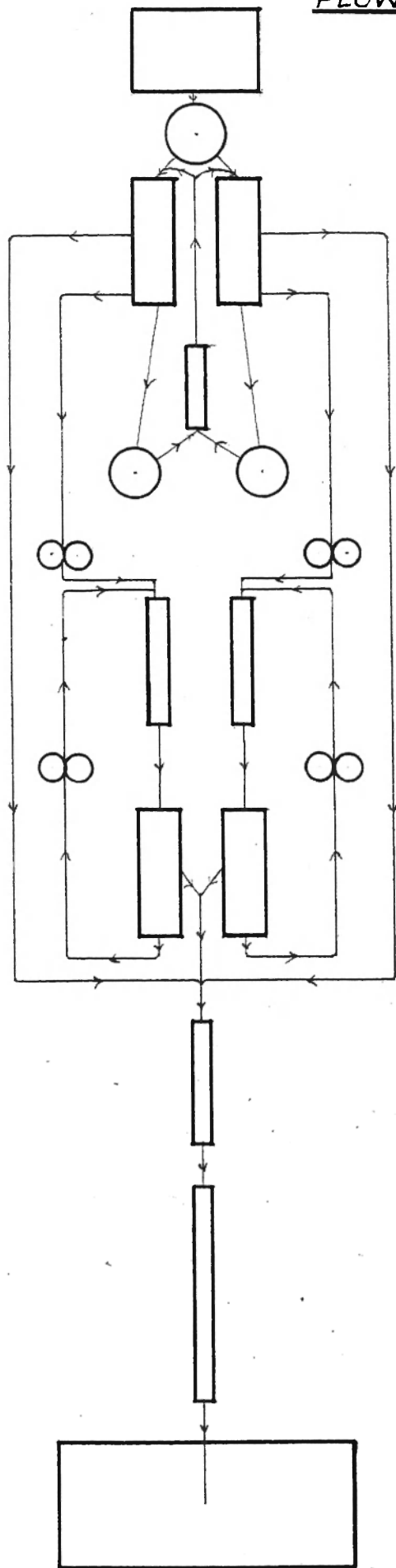
ALLIS CHALMERS COMPANY,

Per (Signed) G. T. Hansen.

GTH/L.

F L O W S H E E T

FLOW-SHEET OF CRUSHING PLANT.



MINE ORE BIN - LUMP ORE.

#7 1/2 - K - GATES BREAKER.

2 - 48" x 16' - GATES SCREENS.
2" - SECTIONS - 9" - DUST JACKET.

1 - #6 - B - CONTINUOUS BUCKET ELEVATOR.

2 - #4 - K - GATES BREAKERS.

2 - 36" x 15" - A - ROLLS.

2 - 18" - VERTICAL ELEVATORS.

2 - 36" x 15" - A - ROLLS.

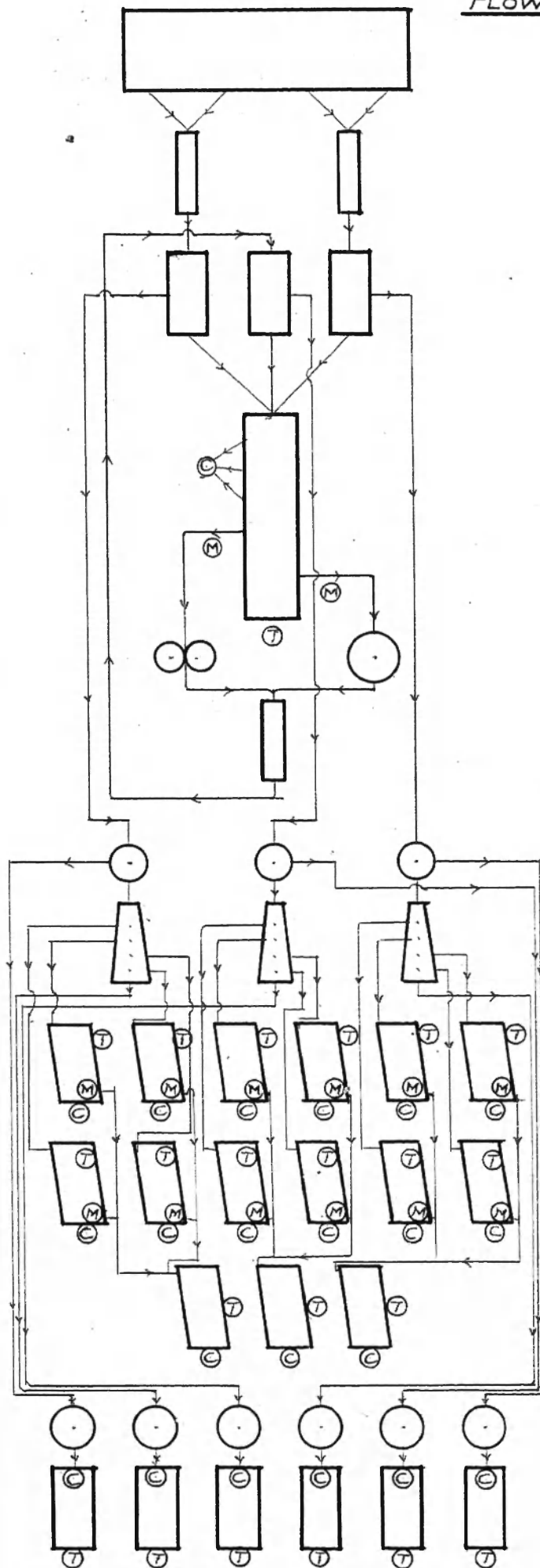
2 - 48" x 16' - GATES SCREENS.
9" - SECTIONS.

20" - HORIZONTAL TROUGHING CONVEYOR.

20" - TROUGHING CONVEYOR - 22" INCLINE.

20" - DISTRIBUTING CONVEYOR -
WITH AUTOMATIC TRIPPER.
MILL ORE BIN - 9" - ORE.

FLOW SHEET - CONCENTRATOR.



MILL ORE BIN - 9% ORE.

4 - SHAKING FEEDERS.

2 - 16" VERTICAL ELEVATORS.

3 - 48" x 108" - TROMMELS.
1" AND 1/2" - PERFORATIONS.

(C) = CONCENTRATES.

(M) = MIDDINGS.

(T) = TAILINGS.

25' - HANCOCK JIG.

6' - HUNTINGTON MILL.

24" x 14" - "B" ROLLS.

16" - VERTICAL ELEVATOR.

3 - 48" - DIVIDING CONES.

3 - 4 - SPIG. RICHARDS H. S. CLASSIFIER.

6 - STANDARD OVERSTROM TABLES.

6 - STANDARD OVERSTROM TABLES.

3 - STANDARD OVERSTROM TABLES.

6 - 8' CALLOW TANKS.

6 - 6' - SUSPENDED VANNERS.

GENERAL CRUSHING PLANT

AND

CONCENTRATOR DRAWING

No.

ALLIS-CHALMERS COMPANY

ALLIS-CHALMERS COMPANY

PROPOSAL

Milwaukee, Wisconsin, U. S. A. May 24th 1930

Potosi Lead, Baryta & Mercantile Company,
(Hereinafter called the Purchaser)

Potosi, Missouri.

Gentlemen:-

Allis-Chalmers Company, hereinafter called the Company, proposes to furnish the Purchaser, on the following conditions, the machinery described below, or in the Company's specifications attached, which are made a part of this proposal, f. o. b. cars point of shipment.

Equipment for mining and Concentrating

Plant with Power, as per attached specifications.

F.O.B. Leadwood, Mo.

All machinery shall be installed by and at the expense of the Purchaser, unless otherwise expressly stipulated herein.

The Company will repair f. o. b. works where made, or furnish without charge f. o. b. its works, a similar part to replace any material of its own manufacture which, within one year after shipment, is proven to have been defective at the time it was shipped, provided the Purchaser gives the Company immediate written notice of such alleged defects. The Company shall not be held liable for any damages or delays caused by defective material, and no allowance will be made for repairs or alterations, unless made by its written consent or approval.

The title and right of possession to the machinery herein specified, remains in the Company until all payments hereunder, (including deferred payments and any notes or renewals thereof, if any), shall have been fully made in cash, and it is agreed that the said machinery shall remain the personal property of the Company whatever may be the mode of its attachment to realty or otherwise, until fully paid for in cash. Upon failure to make payments, or any of them, as herein specified, the Company may retain any and all partial payments which have been made, as liquidated damages, and shall be entitled to take immediate possession of said property, and be free to enter the premises where said machinery may be located, and to remove the same as its property without prejudice to any further claims on account of damage which the Company may suffer from any cause.

The Company agrees that it shall at its own expense defend any suits that may be instituted by any party against the Purchaser, for alleged infringement of patents relating to machinery of its own manufacture furnished under this proposal, provided such alleged infringement shall consist in the use of said machinery, or parts thereof, in the regular course of the Purchaser's business, and provided the Purchaser shall have made all payments then due under this contract, and gives to the Company immediate notice in writing of the institution of such suits, and permits the Company, through its Counsel, to defend the same, and gives all needed information, assistance and authority to enable the Company to do so, and thereupon in case of a final award of damages in such suit the Company will pay such award, but it shall not be responsible for any compromise made without its written consent, nor shall it be bound to defend any suit or to pay any damages therein when the same shall arise by reason of the use of parts not furnished by the Company under this proposal. The Company shall also be notified of, and reserves the right to be represented at any tests which the purchaser may make, in relation to guarantees of operation.

If shipment of the machinery herein specified, or any part thereof, is delayed by any cause for which the Purchaser is directly or indirectly responsible, the date of completion of said machinery by the Company shall be regarded as the date of shipment in determining when payments for said machinery are to be made, and the Company shall be entitled to receive reasonable compensation for storage; such storage to be at the risk of the Purchaser. If all the machinery should not be forwarded on the same date, pro-rata payments shall be made for partial shipments. All notes and securities given to the Company by Purchaser are taken by the Company, not in payment, but as evidence only of Purchaser's indebtedness.

This contract is contingent upon strikes, fires, accidents or other delays unavoidable or beyond the reasonable control of the Company. The Company shall not be held responsible or liable for any loss, damage, detention or delay, from any cause beyond its control; and the receipt of the machinery by the Purchaser shall constitute acceptance of its delivery and a waiver of any and all claims for loss or damage due to any delay.

The Purchaser shall provide and maintain adequate insurance for the machinery herein specified, against loss or damage by fire, in an amount fully protecting the Company. The said policies of insurance are to be made payable to the Company and held by it as collateral security. The Purchaser shall assume all loss resulting from fire in case of failure to effect such insurance.

All the terms and provisions of the contract between the parties hereto, are fully set out herein, and no agent, salesman or other party is authorized to bind the Company by any agreement, warranty, statement, promise or understanding not herein expressed, and no modifications of the contract shall be binding on either party unless the same are in writing, accepted by the Purchaser and approved in writing by one of the Company's Executive Officers and it is expressly agreed and understood that there are no promises, agreements, or understandings, verbal or otherwise, outside of this contract.

This proposal is for immediate acceptance of the Purchaser, and is subject to the written approval of an Executive Officer of the Company, and shall not be binding upon the Company until so approved.

ALLIS-CHALMERS COMPANY,

By_____

ACCEPTANCE.

The foregoing proposal is hereby accepted and agreed

to this_____day of_____190_____

(Purchaser)
(Sign Here)_____

H O I S T

INTENT OF SPECIFICATIONS

GENERAL:-

These specifications are intended to cover a double drum double reduction geared hoist, complete with motor and controlling equipment, all in accordance with specifications below and attached.

HOIST DUTY:-

The hoist will be designed for a maximum rope pull on each drum of 9,800 pounds at a maximum rope speed of approximately 600 ft. per minute. It is understood that the hoist will normally operate in balanced; the above rope pull being balanced by the weight of the descending skip and cage of 5000 pounds, giving the maximum unbalanced rope pull of 4800 pounds. As an emergency condition the hoist will be capable of operating unbalanced for a short period with the above maximum rope pull of 9,800 pounds at the specified rope speed.

SPECIFICATIONS FOR HOIST

DRUMS:-

Drums will be 4' 6" diameter by 3' 6" face and will be grooved for 1" rope and designed to hold 500 ft. of the rope in one wrap. The drum shells will be made of cast iron in halves and bolted together.

The brake wheel and clutch rings will be cast together with the end spiders, to be turned accurately and bolted to drum shafts.

The spiders will be bored and fitted with bronze bushings. The drums will run loose on the shaft. Bushings will be made in halves and will be held to the spider hubs by means of tap bolts. They can be easily removed for replacement when worn.

CLUTCHES AND BRAKES:-

The clutches will be of the improved Allis Chalmers band friction type 4' 0" diameter and will consist of cast steel spiders keyed to the drum shaft with the friction members fastened to them. The steel friction bands will be lined with basswood blocks. The clutches will be hand operated.

The brakes will also be of the band friction type. They will include the brake wheel 6' 8" diameter by 7' face,

cast a part of the clutch rings and end spiders and the brake proper which will be lined with basswood blocks fastened to the hands by means of carriage bolts. The brakes will be hand operated.

GEARS & PINIONS:-

The gears will be made of cast iron. The pinion of cast steel. All teeth of gears and pinions will be cut. The main gear and main pinion will be 1 D.P., with 8" face. The main gear will be 82" pitch diameter and the main pinion will be 15" pitch diameter. The intermediate gear and motor pinion will be 1-1/2 D.P., with 6" face. The ratio of this set of gears will be made suitable to suit the speed of the motor, so as to give a rope speed of approximately 600 ft. per minute.

FRAME:-

The frame will be made of cast iron, will be of the hollow box section type made in sections with plain joints and bolted together. It will be provided with planed pads for the bearings and will be furnished with an extension for the motor. All necessary bolts and keys for bolting the pedestal and motor to frame will be included.

BEARINGS:-

The bearings with the exception of the motor bearings and motor outboard bearing, will be lined with the best quality of babbitt metal and will be provided with oil grooves designed to effect an even distribution of the oil.

The motor shaft extension which carries the motor

pinion will be supported by an outboard bearing, bolted to the frame. The motor bearing and this outboard bearing, will be of the ring oiling type.

The drum shaft center bearing will be 7" diameter by 13" long. The drum shaft and bearings will be 6" diameter by 12" long. The intermediate shaft bearings will be 5" diameter by 10" long.

SHAFTS:-

The shafts will be made of open hearth steel, will be turned accurately and keyseated. The drum shaft will be 7" diameter in the center. The intermediate shaft will be 5" diameter in the center.

INDICATOR:-

An indicator of the column type, one for each drum will be included and will be driven from the drum hubs by chain and cut sprockets.

FOUNDATION BOLTS AND WASHERS:-

All necessary bolts and foundation washers are included in these specifications.

ALLIS-CHALMERS COMPANY

MILWAUKEE, WISCONSIN, U. S. A.

SPECIFICATIONS FOR INDUCTION MOTORS

For Potosi Lead, Baryta & Mercantile Company,

These Specifications form part of Proposal dated May 24th. 1910.

	ITEM	A	B	C	D	E	F
1	Number of Units	One					
2	Type	(ANY)					
3	Normal Rated Capacity, H. P.	120					
4	*Synchronous Speed, R. P. M.	720					
5	Volts	440					
6	Cycles	60					
7	Phase	3					
8	Pulley Diameter	---					
9	Pulley Face	---					
10	Open, Closed or Semi-Enclosed	Open					
11	Temperature rise degrees C full load for 10 hours	40°					
12							
13							
14							
15							
16							
17							
18							
19							
20							
21							
22							

INDUCTION MOTORS.

For Potosi Lead, Baryte & Mercantile Company.

ACCESSORIES—The following apparatus will be furnished:

With Item

- A One reversible drum type controller with resistance.
- B.....
- C.....
- D.....
- E.....
- F.....

(NOTE:—Insert below any additions which may be made necessary by the Purchaser's requirements. If more room is needed, add extra sheets giving them this page number with sub-letters.)

Items inserted below take precedence over the succeeding printed specifications in case of a conflict.

INDUCTION MOTORS.

For.....

PERFORMANCE—When operated at normal voltage and frequency the performance of these motors as regards heating, etc., will be as shown in the Table. Temperatures to be measured by thermometer according to A. I. E. E. Standardization Report. 3

SPEED—Speed at full load will be from 4 to 6 per cent. lower than synchronous or no load speed for motors over 10 H.P. For smaller motors the slip will be from 6 to 8 per cent.

CONSTRUCTION—The stator will be of the slotted type built up of thin sheets of steel of high magnetic quality coated with insulating varnish. The punchings are securely mounted in a cast iron frame or yoke which also carries the end housings and bearings. The yoke is cast in one piece with ample cored openings throughout, thus allowing free air circulation. When enclosed or semi-enclosed motors are required, solid or perforated covers for the openings in the end housings will be provided. The slotted rotor core is built up of annealed sheet steel of the same high quality used in the construction of the stator. The bearings are of ample proportions and are provided with oil reservoirs of liberal dimensions and effective ring oilers. 10 15

WINDINGS—The stator coils are form wound, carefully insulated with the very best materials and securely held in the stator core slots. The rotor winding of the Type "AN" motors is of the squirrel cage type. Each slot contains a single copper bar bolted at the ends to short-circuiting rings of ample capacity. The rotor of the Type "A(NY)" motors is provided with a polyphase winding adapted to the insertion of resistance for starting under load or for speed regulation. 20

~~**RAILS AND BELT TIGHTENER**—Unless otherwise specified, standard motors will be provided with rails constructed with adjusting screws for tightening belt.~~

~~**POTENTIAL STARTERS**—Potential starters used with Type "AN" motors are built with oil-immersed switches of ample capacity to carry the starting current without arcing or burning at the contact fingers. The auto-transformers are provided with the necessary taps to adjust the voltage to suit different starting conditions.~~ 25

VENTILATION—The construction of the motors throughout is such as to obtain a free circulation of air and consequent low temperature.

WORKMANSHIP AND FINISH—The workmanship will be of the highest class. All parts will be made to standard gauges on the interchangeable system. All surfaces not machined will be "dressed," filled and rubbed down to present a smooth finished appearance. 30

ALLIS-CHALMERS COMPANY,

By.....

SKIPS & CAGES:-

Two (2) combined 40 cu. ft. skips and safety cages, made up complete of steel plates, structured shapes and bar steel, according to our latest design. Skips to be self dumping. Cage to be fitted with safety dogs and hinged steel hood.

DUMPING CRADLES:-

Two (2) sets dumping cradles for operating with above skip, to be made up of angles and steel plate, complete.

SHEAVES:-

Two (2) 60" cast iron rope sheaves, complete with shafts and boxes.

ROPE:-

1100' - 1" crucible cast steel hoisting rope.

C R U S H I N G P L A N T

ALLIS-CHALMERS COMPANY

MILWAUKEE, WISCONSIN.

SPECIFICATIONS FOR

GATES STYLE "K" ROCK AND ORE BREAKER

For Potoso Lead, Baryta & Mercantile Company,

These specifications form part of proposal No. 25252 dated May 24th, 1910.

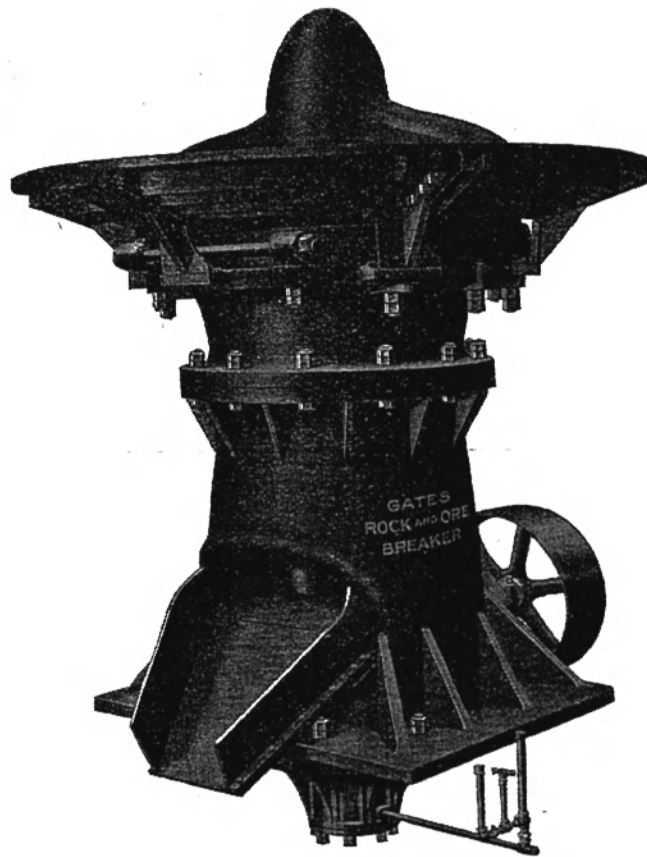
1 Number 7-1/2 Style "K" Gates Breaker, fitted with high-arched 2 arm spider; suspended shaft, head attached to shaft by means of zinc keys; *(band wheel and break pin hub, with four extra break pins;) oil pump and pipes and foundation bolts. 1 set (s) babbitting sleeves for rebabbitting accentric, 1 babbitting mandrel (s) for rebabbitting countershaft bearing, 1 set (s) of wrenches, 1 set (s) lowering rods for lowering bottom plate. Breaker will be Right Angle drive Right hand. Head (or head mantle) will be made of Chilled Iron (chilled iron or manganese steel). Head (or head mantle) will be corrugated (smooth or curraguted.) Concaves will be Chilled Iron (chilled iron, manganese steel, manganese. Size of product desired 3-1/2" Foundation Bolts will be furnished for masonry (masonry or timber) foundation.

Remarks:

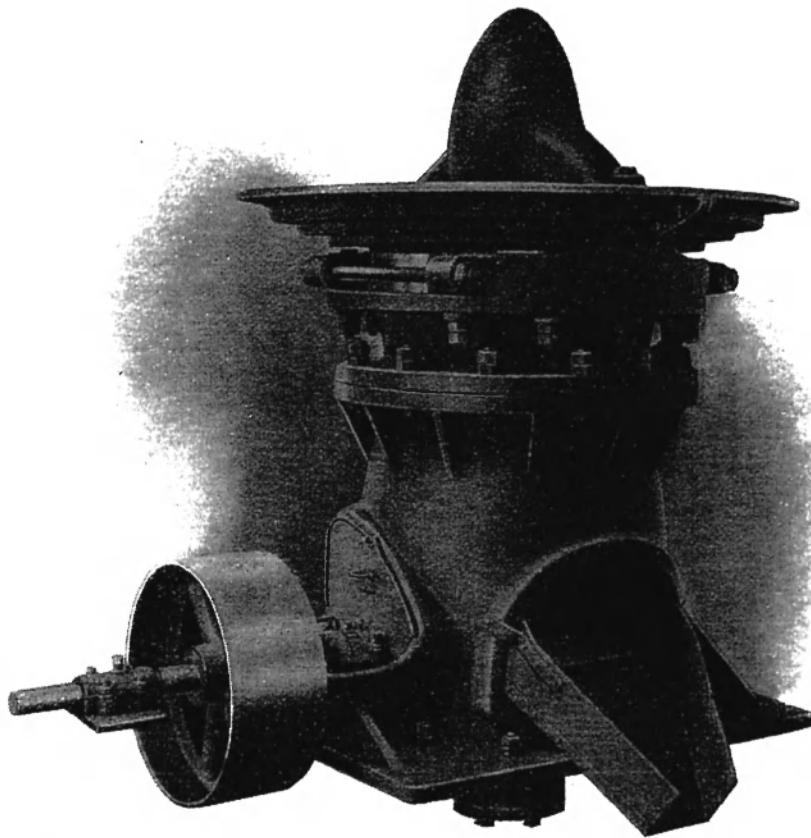
Crusher to be fitted with 18" additional length pinion shaft keyseated for two pulleys and furnished with one extra out-board bearing.

Approximate shipping weight 68100#.

*Our regular machine will be driven by heavy pulley keyed to countershaft, but purchaser has the option and can have band wheel and brake pin hub with pins if preferred.



GATES STYLE "K" BREAKER
With Straight Drive



GATES STYLE "K" BREAKER
With Angle Drive (Left Hand)
(Right Hand Breaker has Pulley on Right Hand facing Spout)

ALLIS-CHALMERS COMPANY

MILWAUKEE, WISCONSIN.

SPECIFICATIONS FOR GATES STYLE "K" ROCK AND ORE BREAKER

For Potosi Lead, Baryta & Mercantile Company,

These specifications form part of proposal No. 25252 dated May 24th, 1910.

2 Number 4 Style "K" Gates Breaker, fitted with high-arched 2 arm spider; suspended shaft, head attached to shaft by means of zinc keys; *(band wheel and break pin hub, with four extra break pins;) oil pump and pipes and foundation bolts. 1 set (s) babbitting sleeves for rebabbitting eccentric, 1 babbitting mandrel (s) for rebabbitting countershaft bearing, 1 set (s) of wrenches, 1 set (s) lowering rods for lowering bottom plate. Breaker will be Straight drive hand.

Head (or head mantle) will be made of Chilled Iron (chilled iron or manganese steel).

Head (or head mantle) will be Smooth (smooth or curraguted.)

Concaves will be Chilled Iron (chilled iron, manganese steel, manganese.

Size of product desired 2"

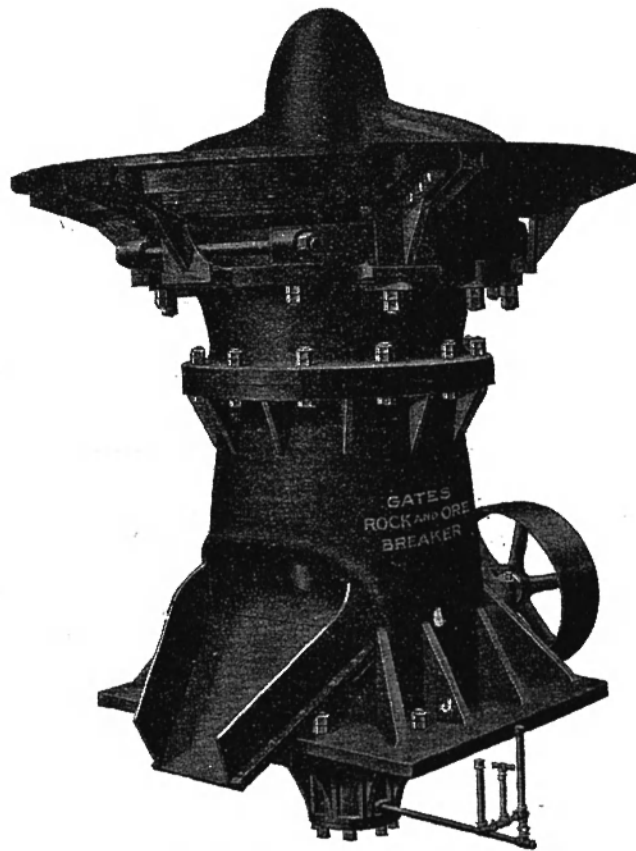
Foundation Bolts will be furnished for Masonry (masonry or timber) foundation.

Remarks:

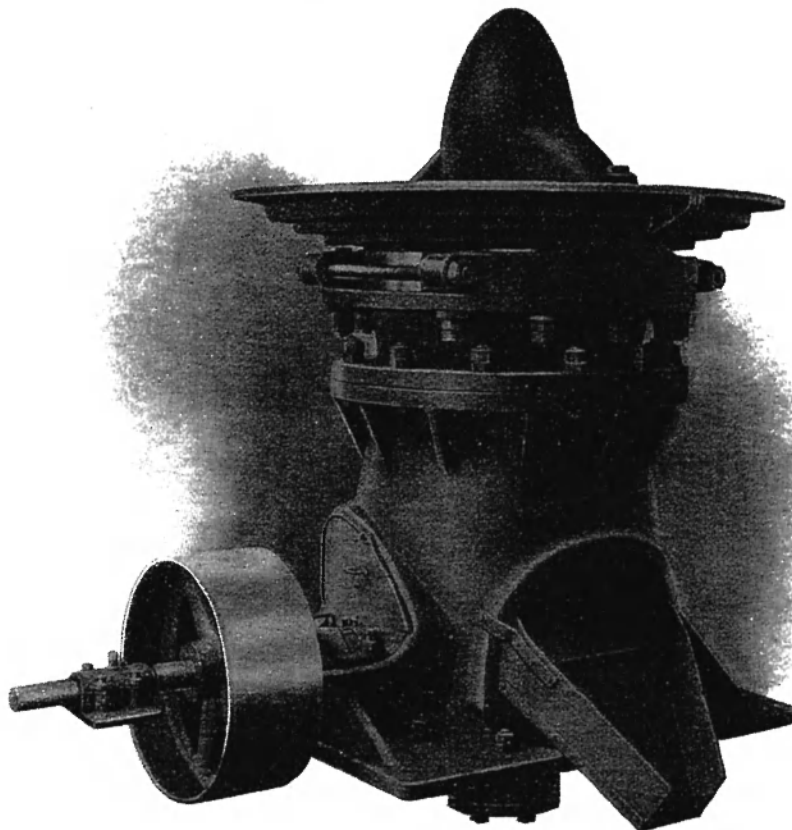
.....
.....
.....
.....
.....
.....

Approximate shipping weight 21780# each.

*Our regular machine will be driven by heavy pulley keyed to countershaft, but purchaser has the option and can have band wheel and brake pin hub with pins if preferred.



GATES STYLE "K" BREAKER
With Straight Drive



GATES STYLE "K" BREAKER
With Angle Drive (Left Hand)
(Right Hand Breaker has Pulley on Right Hand facing Spout)

SCREENS:-

Two (2) 40" x 16' Gates Iron Frame revolving screens, erected on wood frame, complete, screens to be fitted with 2" perforated steel sections throughout and 15' of 9 m/m perforated steel dust jackets, and to be equipped with receiving spout, gear and pinion, pinion shaft extended on additional length of 1-1/2' and to be fitted with 56" driving pulleys. There will be furnished one additional outboard bearing for each pinion shaft on these screens.

Two (2) 40" x 16' Gates Iron Frame revolving screens, erected on wood frames and fitted throughout with 9 m/m perforated steel sections, these screens to be furnished complete with receiving spout, gear and pinion, regular pinion shaft with 56" driving pulley.

ELEVATOR:-

One (1) #6 "B" Gates continuous bucket belt elevator, 40' centers, geared head drive, complete with wood frame, head and boot pulleys, takeup boxes, rollers, belt and buckets, gear and pinion, pinion shaft with an 8' extension in length and 56" driving pulley. There will also be furnished two additional outboard bearings for extra length of pinion shaft.

ROLLS:-

Four (4) 36" x 15" Allis Chalmers type "A" crushing rolls complete, with hoppers and housings, large and small driving pulleys and rolled steel shells, rolls to be

arranged for both longitudinal and transverse adjustment, and to be fitted with safety springs, complete. The first two sets of crushing rolls to be arranged for an operating speed of 90 r.p.m., secondary two sets to be arranged for an operating speed of 100 r.p.m.

MILL ELEVATORS:-

Two (2) 18" x 50' centers Allis Chalmers vertical mill elevators, geared head drive, complete with head and boot pulleys, belt and buckets, takeup boxes, gear and pinion, pinion shaft and driving pulley.

BELT CONVEYOR:-

One (1) 20" x 42' centers troughing belt conveyor complete with plain belt, plain drive, troughing and bottom idlers and top guides, complete.

TROLLEYS:-

One (1) 12 ton, 4 wheel overhead trolley, complete for operating above the #7-1/2 breaker and designed to raise the heaviest piece of this machine.

One (1) 6 ton, 4 wheel overhead trolley for operating above #4 breakers and crushing rolls and capable of lifting the heaviest piece of any one of these machines.

CHAIN BLOCKS:-

One (1) 8 ton triplex chain block, complete, equipped with sufficient chain for a 14' lift.

One (1) 3 ton triplex chain block, equipped with sufficient chain for a 22' lift, complete.

TRANSMISSION:-

The following transmission will be furnished com-

plete as specified.

All shafting to be turned, polished and keyseated according to our plans.

All pulleys to be turned, bored, balanced, keyseated and fitted to their respective shafts.

All bearings to be of the ball and socket flat or bracket type, babitted complete, or a rigid flat type babitted complete for use on light countershafts.

All set collars to be of the safety type with set screws complete.

All couplings to be of the flanged face type, turned, faced and keyseated and fitted to their respective shafts.

All belting to be of the Granite Brand rubber, or of equal quality.

PULLEYS:-

One (1) 22" x 10-1/2" S.B. S.F. K.S. pulley, bored for #7-1/2 breaker pinion shaft.

One (1) 14" x 8-1/2" S.B. S.F. K.S. pulley, bored for #7-1/2 breaker countershaft.

One (1) 42" x 8-1/2" S.B. C.F. K.S. pulley 2-3/16" bore,

One (1) 14" x 8-1/2" " " " " " "

Two (2) 38" x 16" D.B. C.F. K.S. pulleys, 3-15/16" "

Two (2) 76" x 16" " " " " " "

Two (2) 28" x 11" " " " " " "

Two (2) 29" x 9" " " " " " "

Two (2) 34" x 16" " " " " " "

Four (4) 10" x 12" " " " " " "

Two (2) 25" x 9" " " " " " "

Two (2) 52" x 12" D.B. C.F. K.S. pulleys 3-15/16" bore

Two (2) 45" x 11" " " " " 2-7/16" "

Two (2) 28" x 11" " " " " " "

SHAFTING:-

One (1) 2-15/16" x 8' extension elevator pinion shaft.

One (1) 2-3/16" x 18' shaft, keyseated.

Two (2) 3-15/16" x 32' shafts keyseated.

Two (2) 2-7/16" x 6' shafts keyseated.

BEARINGS:-

One (1) extra outboard bearing for #7-1/2 breaker.

Two (2) 2-15/16" plain rigid flat boxes for elevator pinion shaft.

Three (3) 2-3/16" plain rigid flat boxes.

Fourteen (14) 3-15/16" Ball and Socket flat boxes.

Four (4) 2-7/16" plain rigid flat boxes.

SET COLLARS:-

Two (2) 2-3/16" safety set collars,

Four (4) 2-7/16" " " "

Four (4) 3-15/16" " " "

BELTING:-

54' of 16" 5 ply rubber belting,

44' of 10" 4 " " "

46' of 8" 4 " " "

118' of 15" 5 " " "

94' of 14" 5 " " "

102' of 8" 4 " " "

93' of 14" 5 " " "

100' of 8" 4 ply rubber belting.

204' of 11" 4 " " "

90' of 10" 4 " " "

88' of 10" 4 " " "

130' of 10" 4 " " "

One set of steel belting clips.

ALLIS-CHALMERS COMPANY

MILWAUKEE, WISCONSIN, U. S. A.

SPECIFICATIONS FOR
INDUCTION MOTORSFor Potosi Lead, Baryta & Mercantile Company,These Specifications form part of Proposal dated May 24th, 1910.

	ITEM	A	B	C	D	E	F
1	Number of Units	2	1				
2	Type	AN	AN				
3	Normal Rated Capacity, H. P.	100	75				
4	*Synchronous Speed, R. P. M.	720	720				
5	Volts	440	440				
6	Cycles	60	60				
7	Phase	3	3				
8	Pulley Diameter	28"	22"				
9	Pulley Face	15"	12"				
10	Open, Closed or Semi-Enclosed	Open	Open				
11	Temperature rise degrees C full load for 10 hours	40°	40°				
12							
13							
14							
15							
16							
17							
18							
19							
20							
21							
22							

INDUCTION MOTORS.

Item "A" for driving rolls, screens, #4
"K" Breakers and Vertical Mill Elevators in Crush-
ing plant.

Item "B" for driving #7-1/2 "K" Breaker,
Gates Elevator and Conveyor Belt in Crushing Plant.

NOTE.—THIS SHEET IS NOT TO BE INCLUDED IN SPECIFICATION UNLESS SPACE
IS REQUIRED.
ITEMS INSERTED ON THIS SHEET TAKE PRECEDENCE OVER PRINTED SPECI-
FICATION.

INDUCTION MOTORS.

For Potosi Lead, Baryte & Mercantile Company.

ACCESSORIES—The following apparatus only will be furnished with items:

- A. Motors with starters, rails and pulleys.
B. _____
C. _____
D. _____
E. _____
F. _____

PERFORMANCE—When operated at normal voltage and frequency the performance of these motors as regards heating, etc., will be as shown in the Table. Temperatures to be measured by thermometer according to A. E. I. E. Standardization Report.

***SPEED**—Speed at full load will be from 4 to 6 per cent. lower than synchronous or no load speed for motors over 10 H. P. For smaller motors the slip will be from 6 to 8 per cent.

CONSTRUCTION—The stator will be of the slotted type built up of thin sheets of steel of high magnetic quality coated with insulating varnish. The punchings are securely mounted in a cast iron frame or yoke which also carries the end housings and bearings. The yoke is cast in one piece with ample cored openings throughout, thus allowing free air circulation. When enclosed or semi-enclosed motors are required, solid or perforated covers for the openings in the end housings will be provided. The slotted rotor core is built up of annealed sheet steel of the same high quality used in the construction of the stator. The bearings are of ample proportions and are provided with oil reservoirs of liberal dimensions and effective ring oilers.

WINDINGS—The stator coils are form wound, carefully insulated with the very best materials and securely held in the stator core slots. The rotor windings of the Type "AN" motors is of the squirrel cage type. Each slot contains a single copper bar bolted at the ends to short-circuiting rings of ample capacity. The rotor of the Type "A(NY)" motors is provided with a polyphase winding adapted to the insertion of resistance for starting under load or for speed regulation.

RAILS AND BELT TIGHTENER—Unless otherwise specified, standard motors will be provided with rails constructed with adjusting screws for tightening belt.

POTENTIAL STARTERS—Potential starters used with Type "AN" motors are built with oil-immersed switches of ample capacity to carry the starting current without arcing or burning at the contact fingers. The auto-transformers are provided with the necessary taps to adjust the voltage to suit different starting conditions.

VENTILATION—The construction of the motors throughout is such as to obtain a free circulation of air and consequent low temperature.

WORKMANSHIP AND FINISH—The workmanship will be of the highest class. All parts will be made to standard gauges on the interchangeable system. All surfaces not machined will be "dressed", filled and rubbed down to present a smooth, finished appearance.

ALLIS-CHALMERS COMPANY,

By _____

CROSS CONVEYORS

CONNECTING CONVEYOR:-

One (1) 20" x 160' centers troughing belt conveyor, with geared drive, plain belt, troughing and bottom idlers and top guides, conveyor to operate on a 26" incline.

DISTRIBUTING CONVEYOR:-

One (1) 20" x 60' centers troughing belt conveyor with plain belt and bottom idlers and top guides, drive to be geared in combination with the above connecting conveyor for driving from a single pulley according to our plans.

TRIPPER:-

One (1) automatic moveable tripper for 20" distributing conveyors with track and brackets for 60' of operating length, complete.

ALLIS-CHALMERS COMPANY

MILWAUKEE, WISCONSIN, U. S. A.

SPECIFICATIONS FOR INDUCTION MOTORS

For Potosi Lead, Baryta & Mercantile Company,

These Specifications form part of Proposal dated May 24th, 1910.

	ITEM	A	B	C	D	E	F
1	Number of Units	1					
2	Type	AN					
3	Normal Rated Capacity, H. P.	30					
4	*Synchronous Speed, R. P. M.	720					
5	Volts	440					
6	Cycles	60					
7	Phase	3					
8	Pulley Diameter	18"					
9	Pulley Face	11"					
10	Open, Closed or Semi-Enclosed	Open					
11	Temperature rise degrees C full load for 10 hours	40°					
12							
13							
14							
15							
16							
17							
18							
19							
20							
21							
22							

INDUCTION MOTORS.

For Potosi Lead, Baryte & Mercantile Company.

PERFORMANCE—When operated at normal voltage and frequency the performance of these motors as regards heating, etc., will be as shown in the Table. Temperatures to be measured by thermometer according to A. I. E. E. Standardization Report.

***SPEED**—Speed at full load will be from 4 to 6 per cent. lower than synchronous or no load speed for motors over 10 H.P. For smaller motors the slip will be from 6 to 8 per cent.

CONSTRUCTION—The stator will be of the slotted type built up of thin sheets of steel of high magnetic quality coated with insulating varnish. The punchings are securely mounted in a cast iron frame or yoke which also carries the end housings and bearings. The yoke is cast in one piece with ample cored openings throughout, thus allowing free air circulation. When enclosed or semi-enclosed motors are required, solid or perforated covers for the openings in the end housings will be provided. The slotted rotor core is built up of annealed sheet steel of the same high quality used in the construction of the stator. The bearings are of ample proportions and are provided with oil reservoirs of liberal dimensions and effective ring oilers.

WINDINGS—The stator coils are form wound, carefully insulated with the very best materials and securely held in the stator core slots. The rotor winding of the Type "AN" motors is of the squirrel cage type. Each slot contains a single copper bar bolted at the ends to short-circuiting rings of ample capacity. The rotor of the Type "A(NY)" motors is provided with a polyphase winding adapted to the insertion of resistance for starting under load or for speed regulation.

RAILS AND BELT TIGHTENER—Unless otherwise specified, standard motors will be provided with rails constructed with adjusting screws for tightening belt.

POTENTIAL STARTERS—Potential starters used with Type "AN" motors are built with oil-immersed switches of ample capacity to carry the starting current without arcing or burning at the contact fingers. The auto-transformers are provided with the necessary taps to adjust the voltage to suit different starting conditions.

VENTILATION—The construction of the motors throughout is such as to obtain a free circulation of air and consequent low temperature.

WORKMANSHIP AND FINISH—The workmanship will be of the highest class. All parts will be made to standard gauges on the interchangeable system. All surfaces not machined will be "dressed," filled and rubbed down to present a smooth finished appearance.

ALLIS-CHALMERS COMPANY,

By _____

C O N C E N T R A T O R

C O N C E N T R A T O R

FEEDERS:-

Four (4) Eccentric Type Shaking Feeders, arranged to handle a regular feed of 9 m/m ore drawing from the centers of bottom of the steel bins and discharging into main elevators. Feeders to be equipped with handers, eccentrics and tight and loose driving pulleys.

ELEVATORS:-

Two (2) 16" x 45' Centers Geared Head Vertical Mill Elevators with 16" x 7" x 5-1/2" malleable buckets, 18" 8 ply belt, head and boot pulleys, take-up boxes, pinion shaft, gear and pinion, and tight and loose driving pulleys complete.

One (1) 16" x 52' centers Geared Head Vertical Mill Elevators with 16" x 7" x 5-1/2" malleable buckets, 18" 8 ply belt, head and boot pulleys, take-up boxes, pinion shaft, gear and pinion, and tight and loose driving pulleys, complete.

SCREENS:-

Three (3) 48" x 108" Single Right Angle drive trommels with #10 sheet steel housings and discharge receivers steel shafts, ball and socket flat boxes, set collars, bevel gears and special clutch pinions, (described under transmission.) All necessary spiders with steel rims, forged steel

arms and split hubs and sheet steel bands with cast iron buckles. There will be furnished the necessary bolts for attaching trommel to wood frame.

PERFORATED METAL:-

Twenty-five (25) sheets - 40" x 155" - #20 gauge - 1-1/2 m/m perforated sheet steel, rolled to 48" circle - 4" lap. Sheets to be made in two pieces, securely rivetted together. (Covering for one of above trommels.)

Fifty (50) sheets 40" x 155" - #22 gauge, -1 m/m perforated sheet steel, rolled to 48" circle, 4" lap. Sheets to be made in two pieces, securely rivetted together. (Covering for two of above trommels.)

HANCOCK JIG:-

One (1) Standard 25' Hancock Jig, with all fittings including screens, discharge plugs, water valves and pipes for attaching to mill flow, the stands to be erected on a wood frame, and shipped in one piece, the jig box to be erected and shipped in one piece and the screen tray to be erected and shipped in one section. All minor fittings to be of latest design and to embody all improvements incident to successful operation in this district. Jig to be fitted with 1" flanges inside and outside of jig box for 1st, 2nd and 3rd hutch discharge, 2" flanges for 4th and 5th hatches and both sides of jig box and 5" flanges in center of bottom of 6th or tailings compartment. Jig to be equipped with fly-wheel and driving pulley located according to our plans.

HUNTINGTON MILL:-

One (1) #4 "B" Heavy Anaconda Huntington Mill, for concrete base. This mill to be fitted with steel roller rings and ring die, and 8 mesh slotted steel screens. Mill to be equipped with tight and loose pulleys and to be furnished complete, as described in our Bulletin #1431.

HUNTINGTON MILL SCREENS:-

Fifty (50) 8 mesh slotted steel screens for #4 "B" Huntington Mill.

REGRINDING ROLLS:-

One (1) set 30" x 14" Stype "B" Crushing Rolls with rolled steel shells, sheet steel housing, hopper and discharge spout and fitted with 78" x 10-1/2" and 34" x 10-1/2" driving pulleys, complete as described in our Bulletin #1412.

CLASSIFIERS:-

Three (3) 48" diameter sheet steel, single cone classifiers with sub-level inlets and overflow launders and fitted with supporting lugs, complete.

Three (3) 5 spigot Richard's Hindered Settling Classifiers with ironwork and wood-work complete, according to our latest design embodied in our Drawing #X22461.

CALLOW TANKS:-

Six (6) 8' Callow Pulp thickening cones, with sub-level inlet, overflow launder and discharge riser.

OVERSTROM TABLES:-

Nine (9) Standard Right Hand Overstrom tables.

Six (6) Standard Left Hand Overstrom Tables.

These tables to be furnished as shown in our bul-

letin #1421, complete with linoleum tops and copper riffles to be shipped separately and attached by Purchaser.

VANNERS:-

Six (6) Standard 6' Suspended Iron Frame Vanners, equipped with corrugated rubber belts and fitted with new style simplex eccentric and all latest improvements. Machines to be similar to those described in bulletin #1426.

CONCENTRATES CONVEYOR:-

One (1) 64' centers, Disc Drag Conveyor with 6' cast iron discs clamped to wire cable and to be furnished with geared drive, head and tail sprockets and housing complete for dewatering and elevating concentrates.

PIPING:-

One (1) Set Water Piping, Valves and Fittings necessary in the operation of the above concentrator in accordance with our plans.

TRANSMISSION:-

The following transmission:-

All shafting to be turned, polished and keyseated according to our plans.

All pulleys to be turned, bored, balanced and keyseated and fitted to their respective shafts.

All boxes to be of the ball and socket flat or bracket type for line shafts and of the rigid, flat or bracket type for countershafts. All boxes to be babbitted complete.

All couplings to be of the flanged type turned, bored, keyseated and fitted to their respective shafts.

All collars to be of the safety set type.

All belting to be of Granite brand rubber or of equal quality.

One (1) 3-3/16" x 20' shaft, keyseated.

One (1) 2-15/16" x 16' " "

One (1) 2-15/16" x 6' " "

One (1) 2-11/16" x 32' " "

One (1) 1-15/16" x 24' " "

One (1) 2-3/16" x 30' " "

One (1) 2-3/16" x 24' " "

One (1) 1-15/16" x 24' " "

One (1) 1-7/16" x 18' " "

One (1) 1-15/16" x 24' " "

One (1) 1-7/16" x 20' " "

One (1) 3-3/16" to 2-15/16" Flange Face Coupling Fitted.

Two (2) 2-3/16" to 1-15/16" " " " "

Two (2) 1-15/16" to 1-7/16" " " " "

Two (2) 3-3/16" Safety Set Collars.

Two (2) 2-15/16" " " "

Two (2) 2-11/16" " " "

Four (4) 2-3/16" " " "

Two (2) 1-15/16" " " "

One (1) 48" x 11" D.B. C.F. K.S. Pulley 3-3/16" Bore.

One (1) 26" x 25" " " " " 2-15/16" "

One (1) 48" x 11" " " " " 2-15/16" "

One (1) 20" x 11" " " " " 2-15/16" "

One (1) 54" x 11" " " " " 2-11/16" "

Three (3) 20" x 10" " " " " 2-11/16" "

One (1) 11" x 8" S.B. C.F. K.S. Pulley 3-3/16" Bore.
 One (1) 50" x 8" " " " " 2-3/16" "
 Four (4) 14" x 9" " " " " 2-3/16" "
 Five (5) 14" x 9" " " " " 1-15/16" "
 One (1) 38" x 6 1/2" " " " " 1-15/16" "
 Two (2) 10" x 4 1/2" " " " " 1-15/16" "
 Two (2) 10" x 4 1/2" " " " " 1-7/16" "
 Two (2) 14" x 9" " " " " 2-3/16" "
 Two (2) 8" x 4" " " " " 2-3/16" "
 Three (2) 14" x 9" " " " " 1-15/16" "
 Two (2) 8" x 4" " " " " 1-15/16" "
 One (1) 14" x 9" " " " " 1-7/16" "
 Two (2) 8" x 4" " " " " 1-7/16" "
 One (1) 46" x 11" Allis Chalmers Friction Clutch.

Pulley with 21" 3 arm clutch 3-3/16" Bore.

Five (5) 3-3/16" B. & S. Flat Boxes.

Four (4) 2-15/16" " " "

Two (2) 2-15/16" Plain Rigid Flat Boxes.

Seven (7) 2-11/16" " " " "

Six (6) 1-15/16" " " " "

Seven (7) 2-3/16" " " " "

Six (6) 2-3/16" " " " "

Six (6) 1-15/16" " " " "

Four (4) 1-7/16" " " " "

Five (5) 1-15/16" Plain Rigid Bracket Boxes.

Four (4) 1-7/16" " " " "

Three (3) Special Jaw Clutch Pinions with Collars,
 feathers and operating rings and levers,

according to our plans.

42' - 10" - 4 ply Rubber Belting.

62' - 10" - 4 " " "

52' - 10" - 4 " " "

62' - 6" - 4 " " "

34' - 10" - 4 " " "

44' - 10" - 4 " " "

162' - 8" - 4 " " "

42' - 7" - 4 " " "

168' - 3" - 3 " " "

144' - 3" - 3 " " "

30' - 7" - 4 " " "

185' - 3" - 3 " " "

110' - 4" - 3 " " "

25' - 7" - 4 " " "

28' - 7" - 4 " " "

85' - 6" - 4 " " "

100' - 8" - 4 " " "

40' - 10" - 4 " " "

PUMPS:-

Two (2) #5 Morris patented manganese steel lined centrifugal pumps, with 5" inlet and discharge openings. Pumps to operate at a speed of 760 R.P.M. against a total head of 35'. Pumps to be fitted with 14" x 10" pulleys and to operate belted to 20 H.P. motors.

ALLIS-CHALMERS COMPANY

MILWAUKEE, WISCONSIN, U. S. A.

**SPECIFICATIONS FOR
INDUCTION MOTORS**For Potosi Lead, Baryta & Mercantile Company.These Specifications form part of Proposal dated May 24th, 1910.

	ITEM	A	B	C	D	E	F
1	Number of Units	1	1	2	2	2	
2	Type	AN	AN	AN	AN	AN	
3	Normal Rated Capacity, H. P.	5	10	15	40	20	
4	*Synchronous Speed, R. P. M.	1130	850	850	570	1130	
5	Volts	440	440	440	440	440	
6	Cycles	60	60	60	60	60	
7	Phase	3	3	3	3	3	
8	Pulley Diameter	11"	20"	14"	1-17" 1-20"	9-1/2"	
9	Pulley Face	6"	8"	8"	11"	10"	
10	Open, Closed or Semi-Enclosed	Open	Open	Open	Open	Open	
11	Temperature rise degrees C full load for 10 hours	40°	40°	40°	40°	40°	
12							
13							
14							
15							
16							
17							
18							
19							
20							
21							
22							

INDUCTION MOTORS.

For Potosi Lead, Baryta & Mercantile Company.

ACCESSORIES—The following apparatus will be furnished:

With Item

A Pulley, rails and starter.
B " " " "
C " " " "
D " " " "
E _____
F _____

(NOTE:—Insert below any additions which may be made necessary by the Purchaser's requirements. If more room is needed, add extra sheets giving them this page number with sub-letters.)

Items inserted below take precedence over the succeeding printed specifications in case of a conflict.

Item A to operate feeders,

Item B to operate drag conveyor,

Item C to operate tables and vanners,

Item D to operate rolls, elevators, jig, screens and

Huntington Mill,

Item E to operate pumps.

INDUCTION MOTORS.

For Potosi Lead, Baryta & Mercantile Company.

PERFORMANCE—When operated at normal voltage and frequency the performance of these motors as regards heating, etc., will be as shown in the Table. Temperatures to be measured by thermometer according to A. I. E. E. Standardization Report. 5

SPEED—Speed at full load will be from 4 to 6 per cent. lower than synchronous or no load speed for motors over 10 H.P. For smaller motors the slip will be from 6 to 8 per cent.

CONSTRUCTION—The stator will be of the slotted type built up of thin sheets of steel of high magnetic quality coated with insulating varnish. The punchings are securely mounted in a cast iron frame or yoke which also carries the end housings and bearings. The yoke is cast in one piece with ample cored openings throughout, thus allowing free air circulation. When enclosed or semi-enclosed motors are required, solid or perforated covers for the openings in the end housings will be provided. The slotted rotor core is built up of annealed sheet steel of the same high quality used in the construction of the stator. The bearings are of ample proportions and are provided with oil reservoirs of liberal dimensions and effective ring oilers. 10 15

WINDINGS—The stator coils are form wound, carefully insulated with the very best materials and securely held in the stator core slots. The rotor winding of the Type "AN" motors is of the squirrel cage type. Each slot contains a single copper bar bolted at the ends to short-circuiting rings of ample capacity. The rotor of the Type "A(NY)" motors is provided with a polyphase winding adapted to the insertion of resistance for starting under load or for speed regulation. 20

RAILS AND BELT TIGHTENER—Unless otherwise specified, standard motors will be provided with rails constructed with adjusting screws for tightening belt.

POTENTIAL STARTERS—Potential starters used with Type "AN" motors are built with oil-immersed switches of ample capacity to carry the starting current without arcing or burning at the contact fingers. The auto-transformers are provided with the necessary taps to adjust the voltage to suit different starting conditions. 25

VENTILATION—The construction of the motors throughout is such as to obtain a free circulation of air and consequent low temperature.

WORKMANSHIP AND FINISH—The workmanship will be of the highest class. All parts will be made to standard gauges on the interchangeable system. All surfaces not machined will be "dressed," filled and rubbed down to present a smooth finished appearance. 30

ALLIS-CHALMERS COMPANY,

By.....

P U M P S

ALLIS-CHALMERS COMPANY

MILWAUKEE, WISCONSIN, U. S. A.

SPECIFICATIONS No.

FOR

DOUBLE SUCTION, HORIZONTAL SHAFT CENTRIFUGAL PUMP.

For Potosi Lead, Baryta & Mercantile Company,

These specifications form part of proposal dated May 24th, 1910,

Number of pumps 1

Type A.

Capacity, gallons per minute 2000

Total head, feet 58'

Revolutions per minute 1130

Diameter of suction nozzle, inches 8"

Diameter of discharge nozzle, inches 8"

Efficiency, per cent.

Driving connections ... Direct connected to one (1) 60 H.P. 440 volt, 60
cycles, 3 phase Squirrel Cage Induction Motor with potential starter ..
as described in following specifications.

DOUBLE SUCTION, HORIZONTAL SHAFT, CENTRIFUGAL PUMP.

These specifications are written for one pump, but apply to each of as many as are included in the proposal, having the same dimensions.

TYPE—The centrifugal pump will be of the double suction type, so arranged that the water enters the pump from both sides, at and directly opposite the center of the revolving impeller, forming a balanced suction.

The pump will be supported by brackets cast integral with the casing, bolted to, and resting upon the base-plate.

CASING—The casing will be "snail shell" shaped, cast separately from the two side covers.

The casing will be made of close-grained cast iron of suitable thickness, and will be bored and faced where the side covers are secured.

SIDE COVERS—Removable side covers of cast iron will be firmly bolted to the casing. These covers are slightly larger in diameter than the impeller, so that the latter with its shaft may be easily removed.

The suction elbows are a part of the side covers and are designed to give free and easy entrance of the water to the impeller.

IMPELLER—The impeller will be of the enclosed type, made of close-grained cast-iron, having vanes of such shape as will result in the highest possible efficiency when operating under the conditions named in these specifications.

The impeller will be securely fastened to the shaft by an accurately fitted straight key, and held in lateral position by removable composition collars.

SHAFT—The shaft will be made of open-hearth steel, machined true, straight and round, and of ample size to transmit the maximum power required.

COUPLINGS—A pair of plain flanged couplings will be provided.

BEARINGS—The bearings will be located in the covers and consist of several rings in halves, made in such a manner that they may be easily removed without disturbing any other part of the Pump.

These rings will be made of composition, lined with babbitt metal, bored to fit the shaft, and provided with suitable channels to effect an even distribution of the lubricant over the entire surface of the journals.

The bearings will be so arranged that water, grease, or oil, can be used as a lubricant.

The stuffing box through which the shaft passes will be provided with a composition water sealing ring, to prevent air being drawn into and destroying the vacuum in the pump, thereby impairing the suction.

SUCTION "Y" PIPE—A cast iron "Y" pipe will be provided and connected to the suction elbows to form a common suction nozzle.

BASE-PLATE—A substantial base-plate of cast iron for supporting the pump and

which is to be directly connected to the pump shaft, will be furnished.....

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DOUBLE SUCTION, HORIZONTAL SHAFT, CENTRIFUGAL PUMP.

PRIMING AND DRAINING—An opening will be provided at the highest part of the casing for attaching an ejector for the purpose of priming the pump; and a suitable opening will also be arranged at the bottom of the casing for draining the pump.

PAINTING—All unfinished external parts will be painted with a coat of shop paint and the interior of pump will be painted with anti-rust metallic paint.

SHOP ERECTION—The pump will be completely assembled in the shop, all adjoining parts properly fitted, and working clearances checked.

APPURTENANCES FURNISHED—A steam ejector of ample size to quickly prime the pump.

Necessary pipe connections to water sealing rings and bearings.

IN GENERAL—It is intended in these specifications to cover the construction of a pump complete as specified, beginning at the suction inlet flange and ending at the discharge flange. We do not furnish companion flanges for the suction and discharge connections, nor any piping except as herein specified.

Workmanship will be strictly first-class throughout. Materials will be first-class, in kinds and qualities suitable for the various purposes, and free from injurious or unsightly blemishes, in accordance with the best commercial practice.

ALLIS-CHALMERS COMPANY,

By.....

ALLIS-CHALMERS COMPANY

MILWAUKEE, WISCONSIN, U. S. A.

SPECIFICATIONS No.

FOR

DOUBLE SUCTION, HORIZONTAL SHAFT CENTRIFUGAL PUMP.

5

For Potosi, Lead, Baryta & Mercantile Company,

These specifications form part of proposal dated May 24th, 1910.

Number of pumps 1

Type "A" 10

Capacity, gallons per minute 2000

Total head, feet 126

Revolutions per minute 1730

Diameter of suction nozzle, inches 6

Diameter of discharge nozzle, inches 6 15

Efficiency, per cent.

Driving connections .. Direct connected to one (1) 110 H.P. 440 volt, 60

cycles, 3 phase Squirrel Cage Induction Motor as described in follow-

ing specifications.

20

25

DOUBLE SUCTION, HORIZONTAL SHAFT, CENTRIFUGAL PUMP.

These specifications are written for one pump, but apply to each of as many as are included in the proposal, having the same dimensions.

TYPE—The centrifugal pump will be of the double suction type, so arranged that the water enters the pump from both sides, at and directly opposite the center of the revolving impeller, forming a balanced suction.

The pump will be supported by brackets cast integral with the casing, bolted to, and resting upon the base-plate.

CASING—The casing will be "snail shell" shaped, cast separately from the two side covers.

The casing will be made of close-grained cast iron of suitable thickness, and will be bored and faced where the side covers are secured.

SIDE COVERS—Removable side covers of cast iron will be firmly bolted to the casing. These covers are slightly larger in diameter than the impeller, so that the latter with its shaft may be easily removed.

The suction elbows are a part of the side covers and are designed to give free and easy entrance of the water to the impeller.

IMPELLER—The impeller will be of the enclosed type, made of close-grained cast-iron, having vanes of such shape as will result in the highest possible efficiency when operating under the conditions named in these specifications.

The impeller will be securely fastened to the shaft by an accurately fitted straight key, and held in lateral position by removable composition collars.

SHAFT—The shaft will be made of open-hearth steel, machined true, straight and round, and of ample size to transmit the maximum power required.

COUPLINGS—A pair of plain flanged couplings will be provided.

BEARINGS—The bearings will be located in the covers and consist of several rings in halves, made in such a manner that they may be easily removed without disturbing any other part of the Pump.

These rings will be made of composition, lined with babbitt metal, bored to fit the shaft, and provided with suitable channels to effect an even distribution of the lubricant over the entire surface of the journals.

The bearings will be so arranged that water, grease, or oil, can be used as a lubricant.

The stuffing box through which the shaft passes will be provided with a composition water sealing ring, to prevent air being drawn into and destroying the vacuum in the pump, thereby impairing the suction.

SUCTION "Y" PIPE—A cast iron "Y" pipe will be provided and connected to the suction elbows to form a common suction nozzle.

BASE-PLATE—A substantial base-plate of cast iron for supporting the pump and

which is to be directly connected to the pump shaft, will be furnished.....

.....

.....

.....

DOUBLE SUCTION, HORIZONTAL SHAFT, CENTRIFUGAL PUMP.

PRIMING AND DRAINING—An opening will be provided at the highest part of the casing for attaching an ejector for the purpose of priming the pump; and a suitable opening will also be arranged at the bottom of the casing for draining the pump.

PAINTING—All unfinished external parts will be painted with a coat of shop paint and the interior of pump will be painted with anti-rust metallic paint. 5

SHOP ERECTION—The pump will be completely assembled in the shop, all adjoining parts properly fitted, and working clearances checked.

APPURTENANCES FURNISHED—A steam ejector of ample size to quickly prime the pump.

Necessary pipe connections to water sealing rings and bearings.

IN GENERAL—It is intended in these specifications to cover the construction of a pump complete as specified, beginning at the suction inlet flange and ending at the discharge flange. We do not furnish companion flanges for the suction and discharge connections, nor any piping except as herein specified. 10

Workmanship will be strictly first-class throughout. Materials will be first-class, in kinds and qualities suitable for the various purposes, and free from injurious or unsightly blemishes, in accordance with the best commercial practice.

ALLIS-CHALMERS COMPANY,

By.....

ALLIS-CHALMERS COMPANY

MILWAUKEE, WISCONSIN, U. S. A.

SPECIFICATIONS FOR INDUCTION MOTORS

For Potosi Lead, Baryta & Mercantile Company,

These Specifications form part of Proposal dated May 24th, 1910.

	ITEM	A	B	C	D	E	F
1	Number of Units	1	1				
2	Type	AN	AN				
3	Normal Rated Capacity, H. P.	60	110				
4	*Synchronous Speed, R. P. M.	1130	1730				
5	Volts	440	440				
6	Cycles	60	60				
7	Phase	3	3				
8	Pulley Diameter						
9	Pulley Face						
10	Open, Closed or Semi-Enclosed	Open	Open				
11	Temperature rise degrees C full load for 10 hours	40°	40°				
12							
13							
14							
15							
16							
17							
18							
19							
20							
21							
22							

INDUCTION MOTORS.

For Potosi Lead, Baryta & Mercantile Company.

ACCESSORIES—The following apparatus will be furnished:

With Item

- A Potential Starter
- B _____
- C _____
- D _____
- E _____
- F _____

(NOTE:—Insert below any additions which may be made necessary by the Purchaser's requirements. If more room is needed, add extra sheets giving them this page number with sub-letters.)

Items inserted below take precedence over the succeeding printed specifications in case of a conflict.

To be direct connected to

A - 8" Centrifugal Pump,

B - 6" " "

INDUCTION MOTORS.

For Potosi Lead, Baryta & Mercantile Company.

PERFORMANCE—When operated at normal voltage and frequency the performance of these motors as regards heating, etc., will be as shown in the Table. Temperatures to be measured by thermometer according to A. I. E. E. Standardization Report.

SPEED—Speed at full load will be from 4 to 6 per cent. lower than synchronous or no load speed for motors over 10 H.P. For smaller motors the slip will be from 6 to 8 per cent.

CONSTRUCTION—The stator will be of the slotted type built up of thin sheets of steel of high magnetic quality coated with insulating varnish. The punchings are securely mounted in a cast iron frame or yoke which also carries the end housings and bearings. The yoke is cast in one piece with ample cored openings throughout, thus allowing free air circulation. When enclosed or semi-enclosed motors are required, solid or perforated covers for the openings in the end housings will be provided. The slotted rotor core is built up of annealed sheet steel of the same high quality used in the construction of the stator. The bearings are of ample proportions and are provided with oil reservoirs of liberal dimensions and effective ring oilers.

WINDINGS—The stator coils are form wound, carefully insulated with the very best materials and securely held in the stator core slots. The rotor winding of the Type "AN" motors is of the squirrel cage type. Each slot contains a single copper bar bolted at the ends to short-circuiting rings of ample capacity. The rotor of the Type "A(NY)" motors is provided with a polyphase winding adapted to the insertion of resistance for starting under load or for speed regulation.

RAILS AND BELT TIGHTENER—Unless otherwise specified, standard motors will be provided with rails constructed with adjusting screws for tightening belt.

POTENTIAL STARTERS—Potential starters used with Type "AN" motors are built with oil-immersed switches of ample capacity to carry the starting current without arcing or burning at the contact fingers. The auto-transformers are provided with the necessary taps to adjust the voltage to suit different starting conditions.

VENTILATION—The construction of the motors throughout is such as to obtain a free circulation of air and consequent low temperature.

WORKMANSHIP AND FINISH—The workmanship will be of the highest class. All parts will be made to standard gauges on the interchangeable system. All surfaces not machined will be "dressed," filled and rubbed down to present a smooth finished appearance.

ALLIS-CHALMERS COMPANY,

By _____

POWER PLANT

ALLIS-CHALMERS COMPANY

MILWAUKEE, WISCONSIN, U. S. A.

SPECIFICATIONS FOR HORIZONTAL CROSS-COMPOUND REYNOLDS CORLISS ENGINE RELIANCE TYPE

For Potosi Lead, Baryta & Mercantile Company,

These specifications form part of proposal dated May 24th, 1910.

High-pressure cylinder 22 inches diameter 42 inches stroke.

Low-pressure cylinder 44 inches diameter 42 inches stroke.

Revolutions per minute 100 10

Engine to be designed for (condensing or non-condensing) Condensing

Operating conditions { Steam pressure at throttle 150' pounds gauge pressure.

{ Vacuum at exhaust nozzle 26 inches of mercury. (Referred to 30" barometer.)

{ Back-pressure at exhaust nozzle _____ pounds gauge pressure.

High-pressure side is to be (right, left or either) Left hand (See cut on back of this sheet.) 15

Direction of revolution ("over" or "under") _____

Belt ("away from cylinder" or "back by cylinder") _____

Main journals 15 inches diameter 24 inches long.

Crank pins 7-1/2 inches diameter 6-1/2 inches long.

Crosshead pins 7-1/2 inches diameter 6 inches long. 20

Wheel diameter 16 feet. Approximate weight 36000 lbs.

Wheel face Square Rim inches.

Wheel to be crowned for belts of following widths _____

Wheel to be grooved for _____ ropes _____ inches diameter.

Approximate weight of heaviest piece of engine _____ lbs. 25

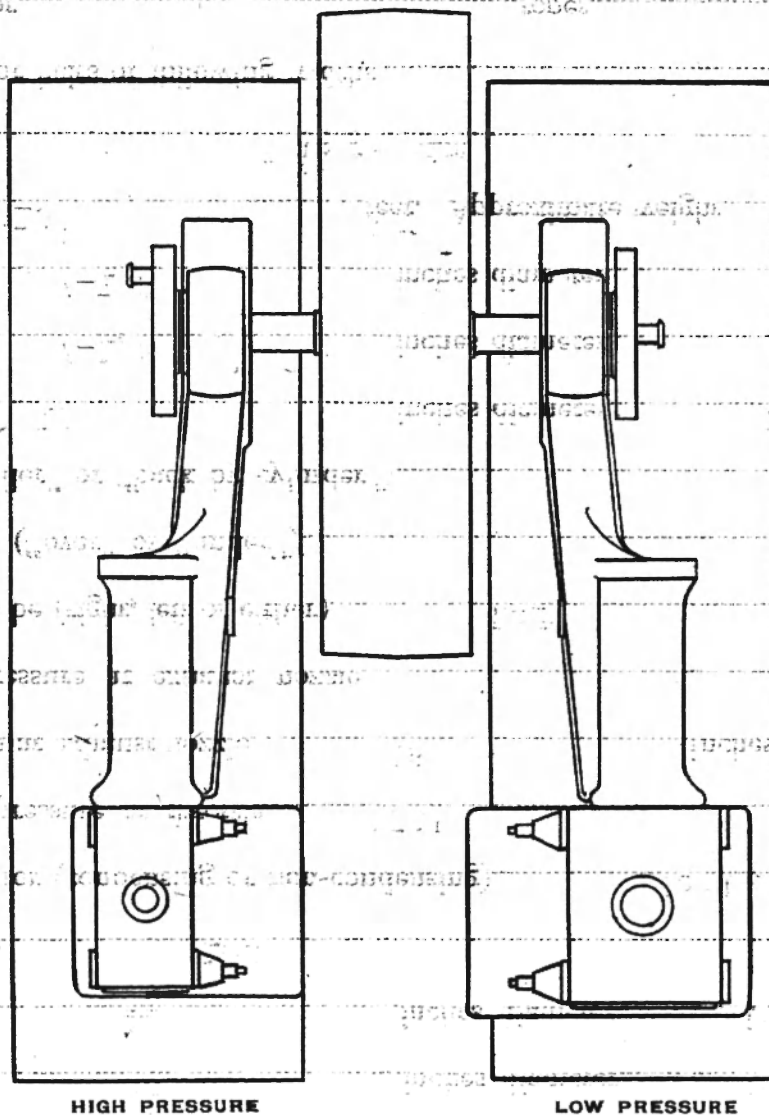
Approximate width and height of largest piece _____ inches x _____ inches.

Kind of service (direct connected to electric generator, or driving what kind of machinery, and how)

Direct Connected to 725 K.V.A. Generator.

HORIZONTAL CROSS-COMPOUND REYNOLDS CORLISS ENGINE-RELIANCE TYPE

CUT BELOW SHOWS HIGH PRESSURE SIDE RIGHT HAND



HORIZONTAL CROSS-COMPOUND ENGINE—RELIANCE TYPE

(If direct connected to an electric generator, the following information is necessary. If we furnish the generator, items marked * need not be given.)

Generator will be (alternating or direct) alternating current, rated at 725 K.V.A. ~~K.W.~~

If alternating current, the frequency will be 60 cycles. 5

The service will be such that the power factor will not exceed 85 per cent.

Engine ~~(is or is not)~~ ^{is not} to drive rotary converters or run in parallel with other units.

Generator will be furnished by Allis Chalmers Company,

Rotor will be (whole or in halves) Approximate weight 219000 lbs.

Flywheel effect of rotor (weight in pounds multiplied by square of radius of gyration in feet) ¹⁰
 WR^2 , approximately

Length on shaft between generator limit lines

Generator is to be located (nearest H. P. or L. P. side)

*Maximum permissible variation in rotation of Alternating Current Generator, either side of uniform rotation, during a revolution, when not influenced adversely by electrical conditions, ¹⁵
 of a geometrical degree.

EXCITER—Is this independent or driven by belt from pulley on engine shaft independent

CYLINDERS—The cylinders will be cast of a hard close grained iron, of a special mixture.

The exhaust passages will be separated by an air space from the cylinder barrels, thus reducing the internal condensation. Cylinders will be tapped so that relief valves can be used if desired, but relief ²⁰
 valves will not be furnished. Cylinders will not be steam jacketed.

SOLE PLATES—Heavy cast iron sole plates with beaded edges to catch drippings of oil and water, will be furnished for the cylinders.

PISTONS—The pistons will be cast iron, heavily ribbed, and fitted with suitable packing ring.

PISTON RODS—The piston rods will be made of open hearth forged steel, highly polished, and secured to ²⁵
 cross-heads by thread and check-nut, so that the clearance space in cylinders can be equalized at any time.

VALVE GEAR—Each cylinder will have the Reynolds-Corliss liberating valve gear. The latches of valve gear will be made of hardened steel, of such form that eight wearing surfaces will be available by change of position; each new position restoring the valve adjustment to the original setting.

The valves will be in cylinders. The valve gear will be so designed that the maximum cut-off will be ³⁰
 limited to not over four-tenths stroke.

Double eccentrics will be used on the low pressure side and a single eccentric on the high pressure side.

GOVERNOR—The governor will be our special type, arranged to control both the high pressure and low pressure cut-offs, and provided with safety stop to prevent the engine running away in case the governor belt should break.

RECEIVER—A suitable receiver will be placed between the cylinders, which, unless otherwise required and specified will be located below the floor and carried on the foundations. A trap will be provided

HORIZONTAL CROSS-COMPOUND ENGINE—RELIANCE TYPE

to drain the receiver of the water collected by condensation. All piping necessary to connect the receiver to the high-pressure and low-pressure cylinders is included. The receiver will be made without reheating coils, and equipped with a pop safety valve and suitable opening for the purpose of connecting a by-pass pipe.

FRAMES—The engine frames will be of heavy box section type, cast in one piece with the slide, strongly ribbed, and having a broad bearing on the foundation throughout its entire length. The slides will be bored where the cross-heads travel, the bored slide reducing the chances of hot journals by allowing the cross-head to travel in any path required by the crank pin, if the engine should get out of level through settling of foundation.

The slides will be bored and the end of frames faced at one setting to insure accurate alignment. The end of slides will be recessed into cylinders.

MAIN BEARINGS—The frames will be fitted with bearings made in three parts, provided with adjustment for taking up wear. The bearings will be lined with babbitt metal, expanded in place, bored and scraped to fit the shaft, and provided with suitable oil channels to effect an even distribution of oil over the entire surface of the journals.

CROSSHEADS—The crossheads will be made of cast iron, polished on the bosses, and furnished with babbitt faced, removable and adjustable shoes, turned and scraped to fit the bored slides. The crosshead pins will be fitted into crossheads with taper fits and securely held in place in such a way as to be easily removed at any time without dismantling the engine.

SHAFT—The shaft will be made of selected open hearth forged steel. The reductions from the diameter at the center to the diameter of journals will be made with long fillets. The diameter of the shaft at center will be proportioned to suit the weight to be carried, the stresses due to the drive, and the necessary distance between bearings.

If direct connected to an electric generator, the shaft will be turned to fit the rotor, according to a gauge of the rotor bore to be furnished by the generator builder, we making such allowance for press fit as may be specified by the generator builder.

The key for rotor is included if required. If it is to be a feather key, it will be fitted up complete to template furnished by generator builder. If it is to be a driven key, it will be finished with allowance for fitting in the field.

The work of pressing the rotor on shaft, or rigging for the same, is not included unless so specified.

CRANKS—The cranks will be of the counterbalanced disc type, pressed on shaft and keyed in place. The crank pins will be forced into cranks and riveted over.

If direct connected to generator, one crank will be left off until the rotor is pressed on, if the rotor is not made in halves. This crank is to be pressed on by the party who presses the rotor on shaft, and who is to be responsible for the same.

CONNECTING RODS—The connecting rods will be made of open hearth forged steel, with solid ends. Both ends of rods will be fitted with bronze boxes, bored and scraped to fit the pins, and with wedge adjustment for taking up wear. The crank pin ends will be lined with babbitt.

WHEEL—The wheel will be so designed and made that it can be safely run at a considerably greater speed than the specified speed of the engine, and will be so proportioned that the stresses arising from centrifugal force will be well within the safe strength of the materials employed.

The wheel will be made in halves according to our regular practice.

Square rim wheels will have pockets cast in the rim for barring.

PRESS FITS—The cranks and crank pins will be forced in place. No shrink fits will be used on any part of the engine.

GAUGE BOARD—A cast iron gauge board, suitable for mounting on a wall, will be furnished, fitted with steam gauge and receiver gauge. With condensing engines a vacuum gauge will also be included, and with non-condensing engines a back-pressure gauge.

HORIZONTAL CROSS-COMPOUND ENGINE—RELIANCE TYPE

OIL GUARDS—A neat oil guard will be fitted at each crank, entirely enclosing connecting rods to prevent throwing oil on floors, etc. With engines for direct connection to generators, eccentric oil guards will also be furnished.

FOUNDATION—There will be furnished a full set of foundation bolts and washers. This does not include foundation bolts for generator unless we furnish the generator. If the purchaser desires the foundation bolts and washers to be shipped in advance of the machinery, it is understood that he shall pay the freight on the same. The purchaser is to provide the foundations, according to plans furnished by us, and such sub-foundations (for which we do not furnish plans) as the local conditions may require. The purchaser is to provide the cement joint between the machinery and foundation after the machinery is properly lined up. This cement joint is to be of a quality satisfactory to, and is to be put in place under the supervision of, our erecting engineer.

PAINTING—All unfinished parts will be filled, rubbed down to a fair and uniform surface, and painted with a coat of shop paint before shipping. No painting after erection is included.

EXCITER PULLEY—If the engine is to be used for driving an alternating current generator, no exciter pulley or room for the same on the shaft is included unless expressly herein specified.

INDICATOR COCKS—The cylinders will be tapped for indicator cocks and plugged, but no indicator cocks or piping are included.

LUBRICATION—The engine will be provided with a sight-feed lubricator, with pipes to connect to cylinders; also centrifugal crank pin lubricators, suitable lubricators for crosshead pins and eccentrics, and such other oil cups as are necessary for the complete lubrication of the engine; the small parts of valve gear, etc., being arranged with oil holes for hand oiling.

Piping to connect the oil cups and drips to a central or tank oiling and filter system in the engine house is not included.

LAGGING AND COVERING—The cylinders will be covered with suitable non-conducting material, and neatly lagged with sheet steel, held in place by polished corner irons. Each back cylinder head will have a false cover.

When the receiver is located above the floor, it will be lagged with sheet steel.

THROTTLE VALVE—A special screw throttle valve of our own make is included.

WRENCHES—Wrenches will be supplied for all parts which require adjustment.

PARALLEL OPERATION—If the engine is to operate a direct connected alternator in parallel with others, it is understood that such parallel operation can only be successful if the other units are suitable for parallel operation. We guarantee that the variation in rotation shall not exceed the specified limit when the engine is driving its generator alone, at any load. We cannot, however, be responsible if, under these conditions, the engine should exceed the permissible limit of variation when thrown into parallel, as any variation from the performance when running alone can only be caused by electrical conditions over which we have no control. Where, however, we furnish all the engines and generators which are to run in parallel, and where we furnish the connecting lines, we take full responsibility for parallel operation.

OPERATION IN GENERAL—It is understood that the conditions of service and operation are to be such as are usual with this class of machinery, unless otherwise specified and fully described.

PACKING FOR SHIPMENT—The various parts of engine will be prepared in such a manner as is customary for domestic rail shipment. Packing for foreign or coastwise shipment is not included unless so specified.

IN GENERAL—It is intended in these specifications to cover the construction of an engine complete as specified, beginning at the inlet flange of the throttle valve and ending at the flange of the exhaust nozzle. We do not furnish, companion flanges for the steam and exhaust connections, piping or packing, except as herein specified.

The purchaser is to furnish all mason and carpenter work and all pipe connections to and from the engine.

HORIZONTAL CROSS-COMPOUND ENGINE—RELIANCE TYPE

The workmanship will be strictly first class throughout. Materials will be strictly first class, in kinds and qualities suitable for the various purposes and free from injurious or unsightly blemishes.

The engine, when properly adjusted and operated, will run without undue vibration. The temperature of the bearings will be well inside of safe limits for such lubricating oils as it is customary to use on engines of approximately similar type and size. 5

The engine will present a handsome appearance, but all strictly ornamental finish will be omitted. Handrailing around flywheel, generator or engine, is not included, it being understood that if such is desired it will be furnished by the purchaser.

No condensing apparatus is included unless so specified. 10

If circumstances should make it impossible to include in these specifications, before execution of the contract, all information which is necessary to enable us to proceed with the work, then it is to be understood that such information is to be furnished immediately. If there should be delay in furnishing us this information, it is to be understood that the shipment named in the proposal is contingent upon all necessary information being furnished immediately, or else the shipment may be delayed accordingly. 15

ERECTING ENGINEER—It is understood that we are to furnish a man to superintend the erection and starting of the engine, as provided for in the proposal, and that we are to have at least two weeks notice to that effect, in order that we may have a suitable man ready for call when needed.

ALLIS-CHALMERS COMPANY,

By..... 20

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ALLIS-CHALMERS COMPANY

MILWAUKEE, WISCONSIN, U. S. A.

SPECIFICATIONS OF

ALTERNATING CURRENT REVOLVING FIELD GENERATOR FLY WHEEL OR ENGINE TYPE

For Potosi Lead, Baryta & Mercantile Company.

These Specifications form part of Proposal dated May 24th, 1910.

K.V.A.
725 K-W., 100 R. P. M., 480 Volts, 60 Cycles, 3 Phase, Poles
Approximate shipping weight 57500 lbs. Rotor 21900 lbs. (net)

CONSTRUCTION—This generator will be constructed with a revolving field and stationary armature, 10
and will be of the A1-72-156-9 type. The field poles will be securely mounted
on cast iron rotor arranged to be pressed
on the engine shaft.

The laminated armature core will be built of steel of high magnetic quality, rigidly mounted in
stator yoke. The yoke will be made of cast iron. 15

NORMAL RATING—The armature will have a 3 phase winding for a normal output of
725 K.V.A.
K-W., viz., 670 amperes per terminal at 480 volts on non-inductive load

EXCITATION—The generator will be separately excited, the exciter being { ~~Direct Coupled~~
Separately driven
~~Belted to Generator~~
The full load voltage of the exciter will be 120 volts.

The exciting current will not exceed 125 amperes when the generator yields its full load 20
current of 746 amperes per terminal, at the normal pressure of 480 volts and at
normal frequency, and 100 per cent. power factor. The generator will require an exciting current of not
more than 165 amperes, when it yields its full current at normal voltage and frequency and at
85 per cent. power factor.

A. C. GENERATOR, FLY WHEEL OR ENGINE TYPE

Form 337
Revised Nov. '06
Sheet 2

For Potosi Lead, Baryta & Mercantile Company.

EXCITER—The exciter will be furnished by Allis-Chalmers Company.

The pulley for driving the exciter will be furnished

REGULATION—A load of 746 amperes per terminal at 100 per cent. power factor may be thrown off, and the E. M. F. will rise approximately 10 per cent. with constant speed and constant excitation. With ~~the same current~~ ^{870 amp.} at 85 per cent. power factor the rise will be approximately 22 per cent.

EFFICIENCY—On non-inductive load the generator will have an efficiency of not less than 92.5 per cent. at full load; 91.2 per cent. at $\frac{3}{4}$ load; 88 per cent. at $\frac{1}{2}$ load.

These efficiencies are calculated from the core losses, as measured by driving the machine with a direct current motor. The $C^2 R$ losses are calculated from the resistance. Friction and windage are not included in the efficiency.

TEMPERATURE AND OVERLOAD—The machine will operate for 24 hours at 480 volts and at 870 amperes per terminal at 85 per cent. power factor, and the rise in temperature in no part will exceed 40 degrees centigrade. At 25 per cent. greater current for 2 hours to follow the above run, the rise in temperature will not exceed 55 degrees centigrade. Temperatures to be measured by thermometer and referred to a room temperature of 25° C. in accordance with Standardization Report of A. I. E. E. The generator is capable of standing a momentary overload of 50 per cent. without injury to any part.

FIELD WINDING—The field winding will be made of copper strip, wound on edge. The field coils are practically indestructible and can carry, in case of emergency, much higher exciting currents than are required for normal load. The insulation of the field winding from the core will be subjected to an insulation test of 1500 volts alternating current for a period of 60 seconds in accordance with A. I. E. E. Standardization Report.

For Potosi Lead, Baryta & Mercantile Company,

ARMATURE WINDING—The armature coils will be wound on forms, carefully insulated with the very best materials, and held in place in the slots by wedges. The insulation of the armature winding from the core will be subjected to an insulation test of 2000 volts alternating for a period of 5 seconds, in accordance with A. I. E. E. Standardization Report.

VENTILATION—Throughout the stator core and windings, ventilating openings will be arranged so that the rotation of the field will set up a forced circulation of air, thus insuring a low temperature.

COLLECTOR—The collector rings will be made of special cast copper of good wearing quality and high conductivity, thus ensuring long life and low temperature at the brushes. At least two carbon brushes per ring will be used, permitting removal, one at a time, for inspection. 10

OPERATION IN PARALLEL—We guarantee successful parallel operation between our generators without "hunting", "racing" or "pumping," providing the variation of the angular velocity of the prime movers does not produce between two generators operating in parallel a displacement of more than five (5) "electrical degrees," ($2\frac{1}{2}$ degrees on either side of mean position); by an "electrical degree" being understood the 180th part of the angle between two poles. 15

WORKMANSHIP AND FINISH—The workmanship will be of the highest class. All parts will be made to standard gauges on the interchangeable system. All surfaces not machined will be "dressed," filled and rubbed down to present a smooth, finished appearance.

PRESSING ON ROTOR—An accurate gauge of diameter of rotor bore will be furnished; a proper allowance to be made by engine builder for press fit of engine shaft in rotor. The work of pressing rotor on shaft, or of pressing on engine crank, or of rigging for the same, will not be included unless so specified. 20

KEYS—Gauges of keyways in rotor will be furnished by us in case there are two or more keyways but we do not furnish keys. 25

SOLE PLATES—will be furnished. Sole plates provide for centering of stator on all machines with rotors over 57-inch diameter, and permit side shifting of stator on all machines having rotors under 180" diameter.

FOUNDATION BOLTS—Foundation bolts will not be furnished unless so specified.

ALLIS-CHALMERS COMPANY,

By _____

S W I T C H B O A R D

The switchboard will be constructed of panels of black marine slate, free from flaws and metallic veins, together with pipe framework. All necessary bus and connection bars and electrical connections between instruments and apparatus mounted on switchboard will be complete; switchboard will consist of the following items:-

- 1 ITEM A. D.C.Exciter and Feeder panel,
- 1 ITEM B. A.C.Generator panel.
- 1 ITEM C. A.C.Feeder panel.

ITEM A.

D.C.EXCITER PANEL: 120 V, 50 Kw, panel 65 x 16, 25 x 16 x 2 3/8" bevel mounting,

- 1 S.F. 250 V, 600 amp circuit breaker, Westinghouse C,
- 1 600 amp ammeter with shunt, Wagner F,
- 1 150 V voltmeter, Wagner F,
- 1 rheostat mechanism,
- 1 5 pt potential receptacle with 4 pt plug,
- 1 T.P.S.T. 250 V, 600 amp lever switch,
- 2 ditto, D.P.S.T. 200 amp with enclosed fuses on base back of panel, (mounting on subbase for lighting.)

ITEM B.

A.C.GENERATOR PANEL: 480 V, 725 KVA 85% PF 60. cy, 3 ph panel, 65 x 25, 25 x 24 x 2, 3/8" bevel, mounting

- 1 D.P. 750 V 1500 amp non-automatic circuit breaker,

Westinghouse C,

- 3 1500 amp ammeters with 5 amp winding, Wagner F,
- 1 600 volt voltmeter, Wagner F,
- 1 300 amp field ammeter with shunt, Wagner F,
- 1 rheostat mechanism,
- 1 D.P.S.T. 250 V, 300 amp field switch with discharge clips,
- 1 8 pt potential receptacle with 4 pt plug,
- 1 6 pt synchronizing "
- 1 T.P.S.T. 600 V, 1600 amp lever switch,
- 2 1500 amp current transformers,

ITEM C.

A.C.FEEDER PANEL: 480 V, 1200 amp 60 cycle, 3 phase panel,
65 x 24, 25 x 24 x 2, 3/8" bevel, mounting.

- 3 T.P.S.T. 500 V, 400 amp quick break lever switches
with enclosed fuses on base back of panel.

EXCITER AND LIGHTING UNIT

One (1) 11" x 12" High Speed Engine direct connected to one (1) 50 K.W., 120 volt, 275 R.P.M. type "I" direct current generator, complete.

A I R C O M P R E S S O R

One (1) Cross Compound Rolling Mill Frame, Meyer
Gear Compressor, with two stage air as follows:-

PRINCIPAL DIMENSIONS OF COMPRESSOR:

Steam Cylinder - Diameter	-----	12/22"
Air Cylinder - Diameter	-----	22/14"
Stroke - Length	-----	18 "
Main Shaft Journal - Diameter	-----	7 "
Main Shaft Journal - Length, each	-----	12 "
Crank Pin) (Diameter	-----	4 "
(Length	-----	4 "
Cross-Head Pin) (Diameter	-----	3 "
(Length	-----	3-1/2"
Steam Pipe - Diameter	-----	3-1/2"
Exhaust Pipe - Diameter	-----	7 "
Air Discharge Pipe - Diameter	-----	4-1/2"
Air Suction Pipe - Diameter	-----	8 "
Fly-wheel or Pulley - Diameter	-----	6'6"
Pulley Face	-----	
Fly-wheel or Pulley - Approximate weight	----	3850 Pounds,
Total weight (approximate)	-----	35,000 "

SERVICE FOR WHICH COMPRESSOR IS PROPOSED:

Displacement ----- 1000 Cubic feed per minute.
Speed ----- 127 Revolutions per minute.

Steam Pressure (at throttle) -----125# condensing.

Air Pressure -----100#.

AIR RECEIVER:-

One (1) 48" x 12' Vertical Air Receiver for 110# working pressure, with gauge and flanges complete.

SEPARATORS:-

One (1) 8" Cochrane horizontal receiver separator equipped with companion flanges, gauge glass and fittings, complete for a steam pressure of 150#.

Two (2) 3-1/2" Cochrane horizontal receiver separator, equipped with companion flanges, gauge glasses and fittings, complete for a steam pressure of 150#.

CONDENSER:-

One (1) Allis Chalmers 42" type "A.N." barometric condenser, complete with standard tail and overflow pipes and exhaust and injection pipes in accordance with our plans. This condenser to operate in conjunction with the cross-compound Corliss Engine above, producing a 26" vacuum (referred to a 30" barometer) with 2000 gallons per minute of water at 70° Fahr. when the above engine is operating at full load.

PIPING:-

One (1) Set steam, water, air and exhaust piping, valves and fittings for the equipment of the interior of the power house in accordance with our plans: also injection water pipe and fittings for conducting water from the injection pump to the condenser; also, reservoir supply pipe and

fittings for conducting water from hot well to storage reservoir; also, will supply pipe and fittings for conducting water from reservoir to mill and connecting with the mill piping system, all in accordance with our plans.

FEED PUMPS:-

Two (2) 7-1/2" x 4-1/2" x 10" brass fitted duplex boiler feed pumps, each pump being capable of feeding 700 boiler H.P. against 150# steam pressure, handling either hot or cold water.

HEATER:-

One (1) 500 H.P. Cochrane feed water heater and purifier, complete.

B O I L E R

NUMBER AND SIZE:

Three (3) Heine Water Tube Boilers of 350 H.P. each in accordance with the following specifications:

HEATING SURFACE GRATE AREA:

Each boiler to have 3535 square feet heating surface, requiring a grate 9'9" wide by 7'0" long, giving 63-2/3 square feet of grate area.

DESIGN OF PRESSURE PARTS:

Each boiler to have:- two shells 36 inches in diameter, 21 feet 4 inches long of 3/8 inch plate; heads 5/8 inch thick and dished; reinforced manhole in rear head with pressed steel cover. Longitudinal seams, double strapped butt joints double riveted; girth seams single riveted, Water-legs made of flanged steel plate, 1/2 inch thick, properly stayed with hollow staybolts, and drop forged throat stays. 202 straight special mild steel tubes 3-1/2 inches in diameter by 18 feet long.

WORKING AND TEST PRESSURES:

All material and workmanship to be first class throughout, the boiler being designed to carry a safe working pressure of 180 pounds per square inch, and to be tested and made tight at 270 pounds hydrostatic pressure before leaving the shop.

FRONTS AND GRATES:

Each boiler to be provided with an ornamental front casing with large doors; fire front with fire and ash pit doors and dead plates; rear and top cleaning doors; covering plates; buck staves and anchor rods; herringbone stationary grates and bearing bars for bituminous coal. Boilers to be provided with front supports for the accommodation of mechanical stokers. Each boiler to have main steam outlet 8" in diameter. Two (2) 3-1/2" nickel seated pop safety valves (Ashton) set to blow at ---pounds pressure. One (1) 12" steam gauge (Standard). Four (4) 1-1/2" blow-off cocks (Cadman). One (1) 2-1/2" feed water valve (Fairbanks). One (1) 2-1/2" check valve (Pratt & Cady). One (1) Reliance water column complete with three gauge cocks and one Huyette quick closing water gauge, all with chains and handles for operating from floor. Necessary pipe for attaching above fittings to boiler.

TILE, TOOLS, ETC.:

Full set of baffle tile, and fire brick jambs and arches for fire doors or cast iron linings as desired. Each boiler to be equipped with complete Bayer Soot Blower System. S-wrench, set of firing tools consisting of slice bar, hoe and two pronged hook, tube scraper with long handle.

We will also furnish one chimney and breeching of No. 10 steel, to connect these boilers to same, all delivered f.o.b. cars Leadwood, Mo.

Chimney to be 70" in diameter by 120' long, one-half of its length to be of 3/16" steel and the remaining half of No. 8; with a base plate which will set on foundation on outside of building.

Chimney to be shipped in sheets, which will be rolled, punched, and nested ready for assembling at destination. We will also furnish sufficient amount of galvanized iron wire strand for two sets of guys (four each), hooks, turn buckles, and rivets necessary for erection.

WEIGHT:

Approximate shipping weight pounds per boiler.

FOUNDATIONS:

Foundations feet below boiler room floor line to be provided by purchaser. The top ten inches to be of hard red brick or concrete molded to proper form.

BRICK SETTING:

The brick work above boiler room floor line to be provided by purchaser will require about 14,000 fire brick, and 58,000 red brick when set two in battery and one singly.

PLANS: .

We will furnish full instructions for erecting, including plans and specifications for the foundations and brick work.

We will furnish the services of a competent engineer to superintend erection for not to exceed 30 days. If detained beyond this time we are to receive for his services five (\$5.00) dollars per day, in addition to his board.

DELIVERY:

These boilers to be delivered f.o.b. cars Leadwood, Missouri. Shipment to be made within 90 days from the date of acceptance of this bid, providing full information needed by us to complete all details is furnished promptly at our re-

quest. Any delays caused by fire, strikes, floods, public carriers or other causes unavoidable or beyond our control excepted.

D R A W I N G S

One set of working detail drawings for the building of the above plant and for the arrangement and erection of equipment therein, in accordance with our plans.

GENERAL OFFICES:
BEST ALLIS WORKS
MILWAUKEE, WIS.

ALLIS-CHALMERS COMPANY

THIRD NATIONAL BANK BLDG.
ST. LOUIS, MO.

CABLE ADDRESS
"FOUNDERS"

August 16th, 1910.

The Board of Regents,
University of Kansas,
Lawrence, Kansas.

Gentlemen:-

The preceding pages represent work done exclusively by G. T. Hansen, our Mining Sales Engineer of this Office during the progress of a mining negotiation.

Very truly yours,


T. S. Benton
ST. LOUIS DISTRICT MANAGER.

NEW YORK CITY.

DENVER, COLO.

SALT LAKE CITY, UTAH.

EL PASO, TEX.

CITY OF MEXICO.



THE MINE AND SMELTER SUPPLY CO.

MACHINERY AND MINING SUPPLIES.

ASSAYER'S AND CHEMIST'S SUPPLIES.

121 TO 125 WEST 2ND SOUTH ST.

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J. SEEP, Vice Prest.
J. FENNESSY, Treas.
ARK GROVE, Secy.
J. SEEP, Asst. Secy.
J. LOVELAND Gen. Mgr.

J. GATES,
LOCAL MANAGER.

P. O. BOX 1358

SALT LAKE CITY, UTAH. Aug. 24, 1910.

ADDRESS ALL BUSINESS COMMUNICATIONS TO THE COMPANY.

Board of Regents,
University of Kansas,
Lawrence, Kan.

Gentlemen:-

This is to testify that Mr. G. T. Hansen was in my employ for several years, while I was manager of the Mining Machinery Department for the Allis Chalmers Company. During that time, Mr. Hansen was engaged in work pertaining to Mining Engineering particularly in the design, construction and operation of Metallurgical plants. As I remember Mr. Hansen was in my employ about three or four years.

Yours very truly,


General Manager.

GENERAL OFFICES:
WEST ALLIS WORKS
MILWAUKEE, WIS.

ALLIS-CHALMERS COMPANY

THIRD NATIONAL BANK BLDG
ST. LOUIS, MO.

CABLE ADDRESS
"FOUNDERS"

November 4th, 1910.

Board of Regents,

University of Kansas,

Lawrence, Kansas.

Gentlemen:-

I have followed very closely the work which Mr. G. T. Hansen has done upon the thesis in application for Degree of Mining Engineer from your University. Mr. Hansen before coming with the Allis-Chalmers Company was engaged in active mining engineering and has been in the employ of the Allis-Chalmers Company for the past four and a half years, during which time he has been wholly engaged in mining engineering and the designing of various classes of mining plants and engineering installation and operation of same.

Mr. Hansen's thesis upon the Potosi Lead, Baryta & Mercantile Company's installation shows his ability as a Mining Engineer and what he has accomplished during the time since he has left the University.

It is with pleasure I recommend Mr. Hansen as to his proficiency and ability and his being entitled to the Degree of Mining Engineer.

Very truly yours,

ALLIS CHALMERS COMPANY,

T. J. Quinlan
DISTRICT MANAGER.

FLB/L.

ALLIS - CHALMERS COMPANY

OFFICE OF
PRESIDENT.

GENERAL OFFICES - WEST ALLIS WORKS.

CABLE ADDRESS
"FOUNDERS"

MILWAUKEE, WIS.

Milwaukee, Wis., October 24, 1910.

Board of Regents,

Kansas University,

Lawrence, Kansas.

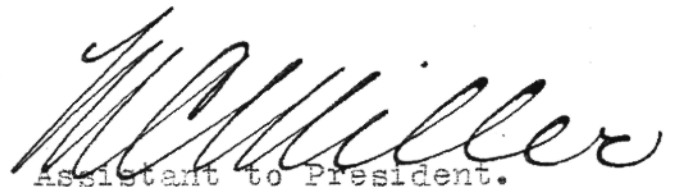
Gentlemen:-

Mr. G. T. Hansen has advised us that he is an applicant for the Degree of Mining Engineer from the Kansas University and that you desire information regarding his connection with the mining work of this Company.

Mr. Hansen has been in our employ between four and five years and during all of this time has been actively engaged in the engineering and design of mining plants, and the subsequent installation and operation of same.

We take great pleasure in recommending Mr. Hansen's professional qualifications to you for the Degree which he seeks.

Yours truly,


Assistant to President.

MCM-W

ALLIS-CHALMERS Co.,

732, Salisbury House,

LONDON.

1st September 1910.

Board of Regents,
University of Kansas,
LAWRENCE, Kansas, U.S.A.

Gentlemen,

Mr G.T. Hansen, with whom I have been associated for a number of years, has asked me to write you regarding his qualifications for his professional Degree of Mining Engineer.

I take pleasure in stating that Mr Hansen has been associated in Mining and Metallurgical work with our Co., and I have known of his associations for the last four or five years.

I believe in personal qualifications and professional characteristics that Mr Hansen is entitled to the receipt of a Degree from your University.

Yours faithfully,

(Signed) H. I. KEEN.

Manager, London Office.

LIX/EAD: